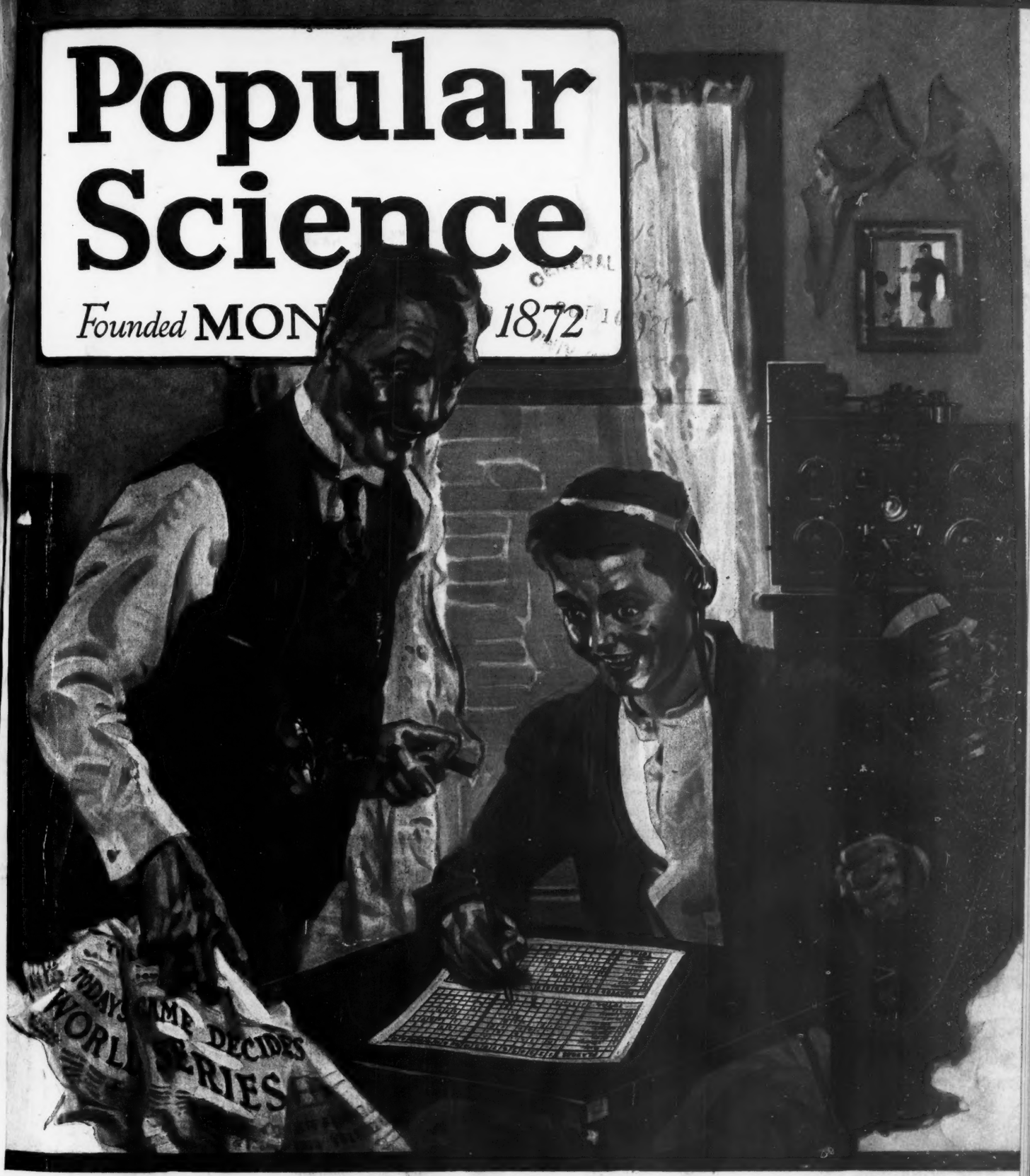
Popular Science

Founded MON[illegible] *1872*



Get the Worlds News by Wireless

Every Home Can Listen-in with a Simple Radio Outfit – See Page 21

Useful Things to Do With Tools — Japan's New Naval Monsters

NOVEMBER — 200 New Practical Inventions — 25 CENTS

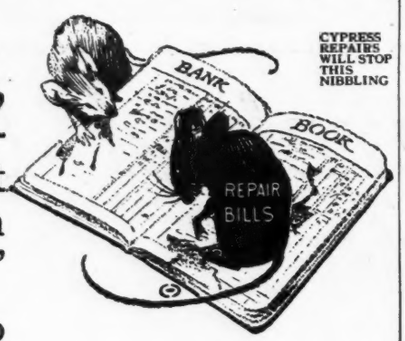
"HE WHO LOOKS BEFORE HE LEAPS BUILDS OF CYPRESS AND BUILDS FOR KEEPS."

REPAIR NOW WITH CYPRESS

AND NEVER HAVE TO REPAIR AGAIN!

"Too bad 'the Wood Eternal' wasn't used at first. Then we wouldn't be bothering with this fixing up job."

True enough, "it's the frequent repair bills that eat the little holes in the bank account."



Why not stop them?

"Build of Cypress and You Build But Once"

but be sure you get the genuine

"Of Course" "TIDE WATER" CYPRESS "THE WOOD ETERNAL" "Of Course"

and be sure it is "thoroughbred" lumber, whose superior manufacture is attested by the famous Cypress trade-mark shown below. Look for it on every board or bundle. Insist on **identified responsibility.** It means "double your lumber money's-worth."

It is possible that we might have a booklet you could use to advantage—we have 43 of them in the Cypress Pocket Library. Some have plan-sheets—big and practical and artistic—and exclusive—and they cost us something—you nothing. Volume One contains the list. Also what the Government of the U. S. A. says about Cypress, "the Wood Eternal." Our address is below. What is yours? Is it all right to ask?

All-round Helps Department

Southern Cypress Mfrs. Association

1249 Poydras Bldg., New Orleans, La., or, 1249 Graham Bldg., Jacksonville, Fla.

INSIST ON TRADE-MARKED CYPRESS AT YOUR LOCAL LUMBER DEALER'S. IF HE HASN'T IT, *LET US KNOW IMMEDIATELY*

THINGS YOU NEED TO KNOW

Fascinating Features in the next issue of Popular Science Monthly

EVERY well-informed man in America will want the news of some of the year's most interesting scientific achievements, described in the December issue of Popular Science Monthly.

You will find in the December issue scores of fascinating bits of new knowledge which will make just so many essential paving-blocks in the road to your own success.

Here's a glance at some of them:

Men Who Made Millions in Radio

A story of how you can get in at the start on the infant game of wireless operating, and of what chances it will bring you for adventure, success, travel, and wealth. Read about men who started as office boys, and now, in their thirties, are millionaires.

Mapping Up the Last Unknown Corners of the Earth

Do you realize that explorers this year have initiated the greatest period of exploration the world has ever known? Do you know that when the present era of discovery is over, the earth's surface will have practically no unprobed secrets, and explorers will have to turn to the moon to seek really new adventures? Read in the December issue the story of where intrepid explorers are going this year, and of what they hope to discover.

Night Travel in Pullman Buses

The most extraordinary motor news of the year concerns the new Pullman autobuses, which have been tried out for intercity travel. A remarkable article in the December issue gives the first picture to the American public of what overnight transportation between cities will be like when the sleeper-bus systems are perfected.

The New Car Has Its Say

In this, the November number, you will find the first part of a remarkable debate on the question, "Shall I Buy a New or a Used Car?" The arguments brought forward on page 34 of this issue in behalf of the used car will be answered next month by an expert, who defends the new car.

Wireless Warfare Next

If there is another war, just what will its battles look like? The disarmament conference, soon to be held in Washington, has set all mankind to thinking about the staggering methods of slaughter with gas and machinery which will inevitably characterize another international conflict. Actual pictures of these methods will be one of the most significant and startling features of the next issue of Popular Science Monthly.

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November, 1921; Vol. 99, No. 5
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How I Listen In on the World by Radio

New, low-priced receiving-sets now bring amazing wireless adventures to every home

By Armstrong Perry

Wake Up to Wireless!

Do you realize that the use of radio outfits for entertainments in the home is spreading through America like wildfire? Do you know that there are nearly half a million wireless fans in the country today and that the thing is only started? If you aren't awake yet to the recreation you can get from a wireless receiving set—the concerts, dance music, news, and public speeches it will bring you—this article by Armstrong Perry will prove unusually fascinating to you—The Editor.

UP to the instant when I thrust a wire into the air and pulled down somebody's jazz, I thought wireless was something like a fire extinguisher or a lifeboat—an emergency apparatus for a ship to use in case of accident, but of no immediate use to ordinary folks like myself.

My great awakening to the romance of radio came when a friend of mine, who had the wireless hobby, urged me to purchase a cheap receiving-set at an electric supply store.

"What is the simplest wireless outfit that I can hear something with?" I asked. He surprised me with his answer.

"The simplest receiving-set consists of an aerial, a detector, a phone shunted around the detector, and a ground-wire."

Except for the meaning of the words "aerial," "detector," and "ground-wire," I understood him perfectly.

Seeing that I was in doubt, he went on to explain that wireless messages come through the air in electrical waves like ripples on a pond. The aerial, he said, was a wire put up in the air. The electrical waves washed against it and some electricity trickled down to the detector. The detector, according to him, was a valve which let electricity go through in one direction but not in the other. The "juice" gathered by the aerial from the passing electrical waves was alternating current—called "a. c." for short. It changed its direction of motion more times a second than the needle on a sewing-machine. But the detector changed the current so that it went into the telephone in spurts, always moving in the same direction, like steam from an engine exhaust-pipe. That was plain enough.

When the coil of wire in my hand touched the metal pipe, I nearly jumped out of my shoes, for right at my ears I heard—jazz!

Then he went on to add that all I had to do to shunt the phone around the detector was to hitch one of the two loose ends of the phone cord to one binding-post of the detector and the other loose end to the other binding-post, and that I was then to hitch one binding-post of the detector to any convenient water-pipe by the shortest practicable piece of wire. This was my ground-wire. The aerial wire was to be hitched to the other binding-post, and then I should be all set to receive messages. This made two wires attached to each binding-post of the detector of the wireless apparatus.

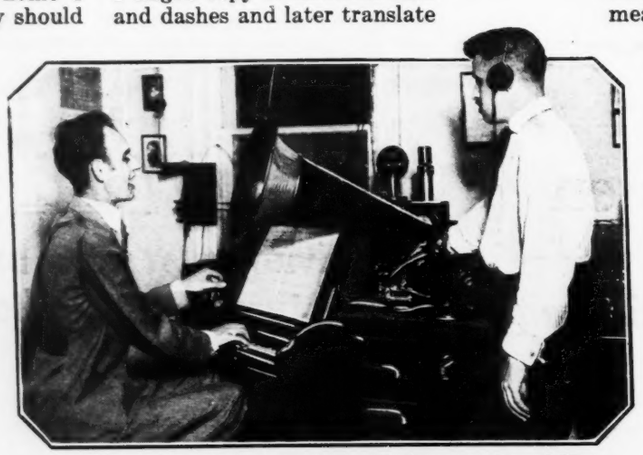
The only adjustment I should have to make was on the detector. In this piece of apparatus the tip of a small wire rested on the polished surface of a piece of galena, or lead ore. The galena, he said, was more sensitive in some

spots than in others, just as a person is more ticklish on the bottoms of his feet than elsewhere. If what I heard was not loud enough, he said I should have to move the wire till I found a tickle spot.

Within a few days after this conversation, I took home a complete radio receiver which had cost me only a few dollars. On my way home I began to feel ridiculous. Why should I, who knew nothing about such a mysterious and technical thing as wireless, expect that I could pick up messages from the air with a cheap outfit not much bigger than a baseball? However, that evening I brightened up the water pipe with a file, wrapped several turns of the ground-wire around it, fastened it tight, and dropped on a bit of solder melted from an old tin can. Then I stapled the wire to the mop-board and brought the end up to the table where my detector and phone lay. There I made the connections according to instructions and put the receivers on my head.

With one end of the aerial wire attached to the detector, I stepped out on to my sleeping-porch with the coil. While figuring out where to anchor the outer end, I put up my hands to take hold of the galvanized-iron pipes that supported the canvas roof. When the coil of wire in my hand touched the metal pipe, I nearly jumped out of my shoes, for right at my ears I heard—jazz! That radio outfit couldn't wait for me to get the aerial up! It was using the porch frame.

In the days that followed I spent hours listening in. Sometimes I heard music, sometimes voices, but more often the dots and dashes of the international Morse code. These, of course, were unintelligible to me, and yet as time went on, certain combinations began to have a familiar sound. At nine-thirty every evening some station sent some sort of a message very slowly and distinctly. It occurred to me that I might copy it down in dots and dashes and later translate it by referring to a copy of the code, which had been given to me when I purchased my outfit.



Laurence M. Cockaday, amateur wireless operator of New York, conducting a concert that reaches an audience estimated at from 100,000 to 150,000 people. His concerts have been heard all over the eastern half of the continent, as far south as Cuba and 800 miles out at sea

I tried the stunt one night and managed to translate this message:

"QST QST QST de NAH NAH NAH.

"Amateur Broadcast: If you are interested in this broadcast, please advise by mail, United States Navy, Radio Amateur Bureau, New York."

At once I wrote a letter saying that I was very much interested. In reply I received a request to answer on an enclosed blank certain questions about myself and my station and a promise that on receipt of the information the Navy would send me a copy of certain secret codes used in sending out messages for amateurs.

Promptly complying with the request, I was given a number as a registered amateur and I soon began to recognize certain letters so readily that I could write them immediately, without going through the slower process of setting down dots and dashes and translating them later. Secret codes are made by substituting certain letters for others. For instance, where you receive an "a" it may mean "b" and so on. The key furnished by the Navy enables you to decode messages.

One night, to my astonishment, I found my own name at the beginning of a message. Imagine the thrill with which I took out of the air a reply by the Navy Radio Amateur Bureau to a letter I had written them the day before! Let me tell you that it's the thrill of a lifetime when your government first communicates with you direct by wireless, and you get the message out of the air yourself.

From then on the Morse code came easily. Listening in on the standardized form of the weather forecast, transmitted from naval stations, was excellent practice. I soon found myself able to catch the concentrated digest of the world's news that is transmitted every evening. At first I would wrestle for an hour, trying to piece together disconnected letters that I had grabbed out of the rapidly running procession, but at last I came to a point where I could turn to the family during a three-minute intermission and tell them what was going on in London, Tokio, and Rio de Janeiro at the moment, and add the day's baseball scores.

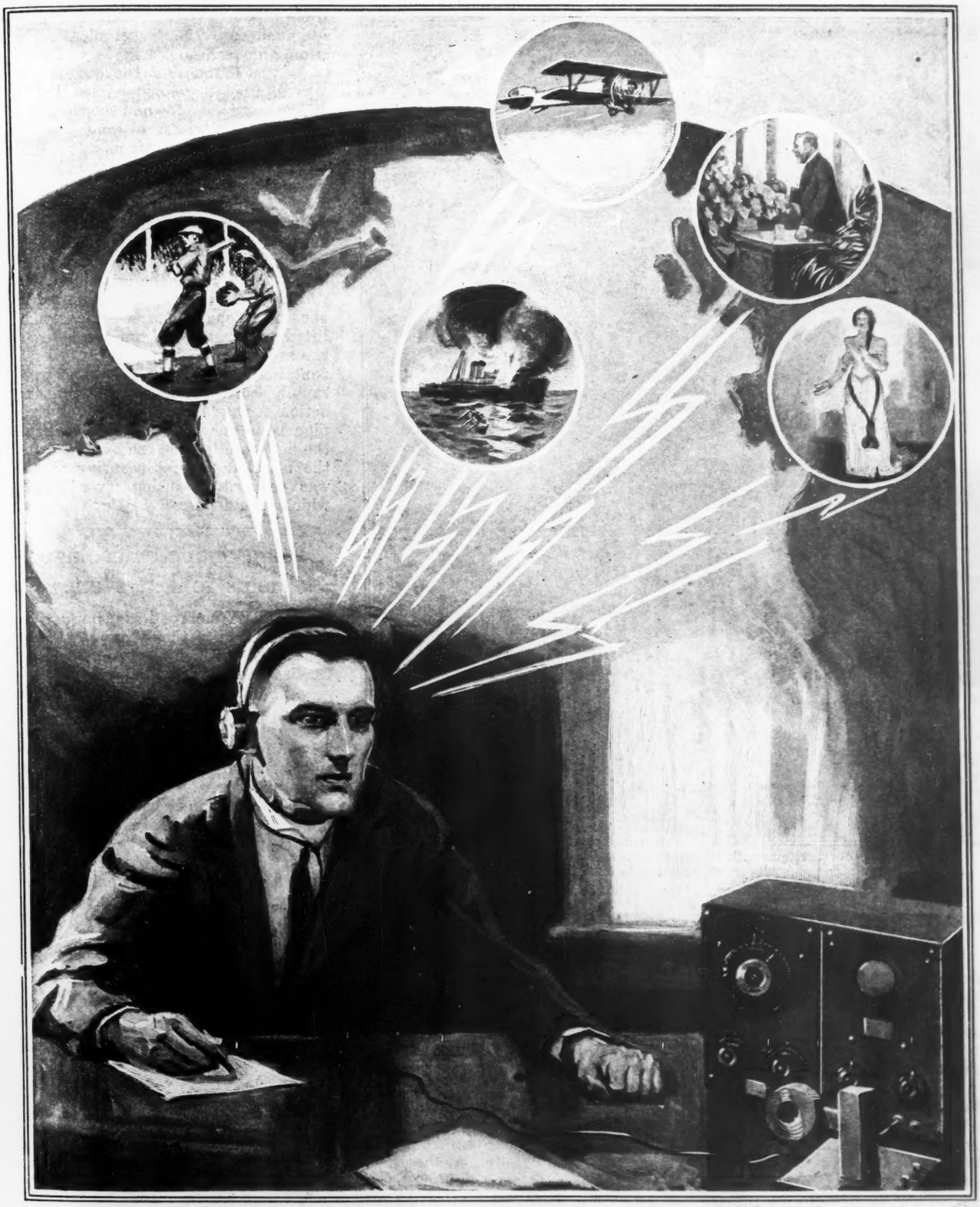
In the meantime my station was growing. The first addition was a

(*Continued on page* 102)

This small receiving-set, typical of outfits costing from $10 to $15, consists of a tuner, a detector, and one phone. It is said to have a telegraphic code range of several hundred miles, depending on local conditions

After graduating from the beginners' class, the radio fan may want this more expensive short-wave regenerative receiving-set, with its wave length of 180 to 700 meters. Sets of this type retail for about $125

This entirely practical set is one of the latest to be put on the market. It falls in the class costing about $25. It will receive messages sent out from radio stations having wave lengths up to 500 meters



Wireless Wonders of Today and Tomorrow

BROADCASTING of news by radiophone, and of lectures, addresses, and concerts, is being carried on from many cities. Farmers in Wisconsin, Missouri, and other states are receiving weather and crop reports, concerts, and news by radio from their state capitals.

The area of 125,000 square miles directly covered by radiophone reports of the Dempsey-Carpentier fight is small compared with the area that will soon be covered by nightly radio broadcasts on every conceivable subject.

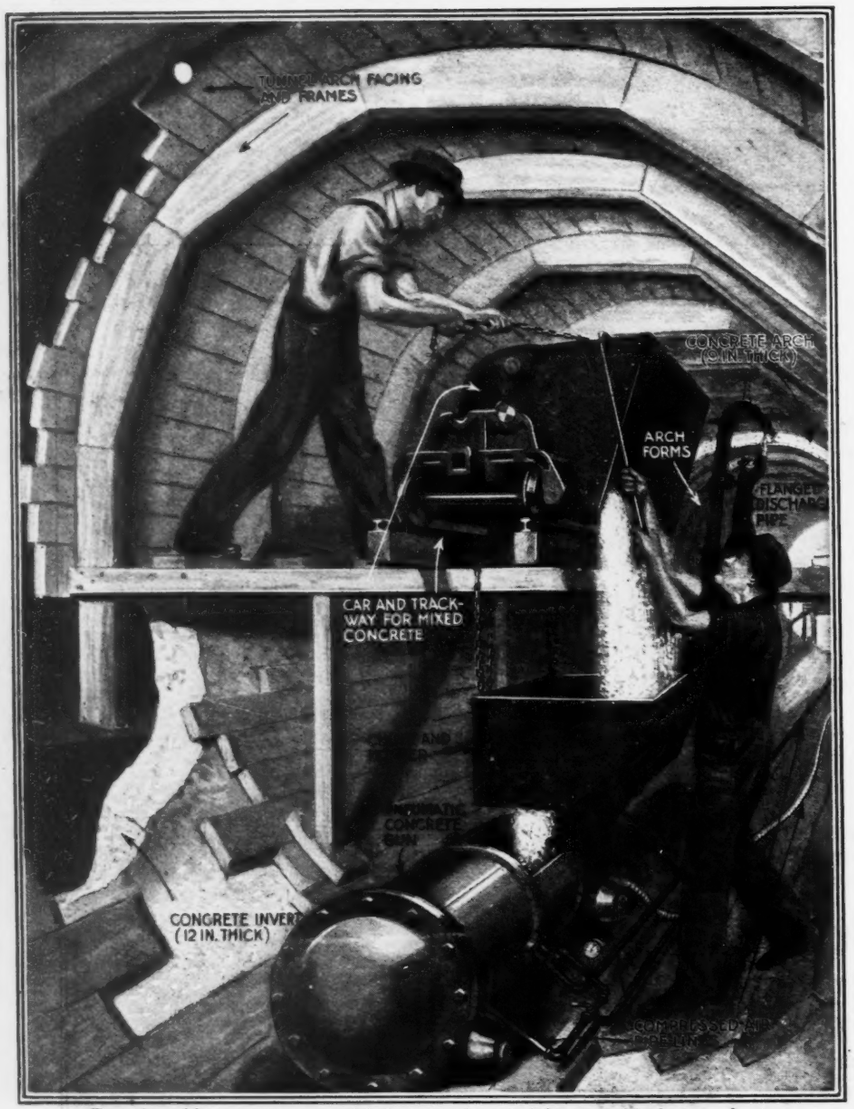
Three chief problems still stand in the way:

The first is the perfection of an extremely low-priced, wide-range receiving-set that anybody can operate.

The second is the elimination of static disturbances that produce buzzing confusion in the receiver.

The third is a solution of the mystery of "pockets." These are inexplicable spots, such as Saratoga, New York, where messages, audible all around, cannot be heard.

A fortune is waiting for the man who helps solve these problems. Every radiograph expert says that eventually they will be solved


TUNNEL ARCH FACING AND FRAMES
CONCRETE ARCH (12 IN. THICK)
ARCH FORMS
FLANGED DISCHARGE PIPE
CAR AND TRACK-WAY FOR MIXED CONCRETE
CONCRETE INVERT (12 IN. THICK)

By using this concrete gun with its capacity of eighteen cubic feet a minute, more than nine thousand feet of tunnel were lined in four months' time

Pneumatic Gun Lines Tunnel with Concrete

A CONCRETE lining nine inches thick was shot into place on the overhead arch of the Caribou (California) hydroelectric tunnel by a pneumatic gun which placed eighteen cubic feet of concrete a minute. The tunnel was ten feet in diameter, and the maximum advance in twenty-four hours was 156 linear feet of arch, while an average of a hundred and five linear feet was maintained over a period of twenty-five days. The rapidity with which this tunnel was completed was largely due to the use of a pneumatic concrete ram.

The new concrete gun differs from other machines previously constructed along the same general design in that the charge is started through the delivery pipe by a piston. Mixed concrete is deposited in the gun chamber. A normal air pressure of from ninety to one hundred pounds a square inch is used to deliver the concrete only on the last two hundred feet of the distance from the mixer to the heading. The gun is mounted on wheels and is moved along the invert as lining progresses. The forms are built while the concrete is being placed.

The construction of the gun is shown by the accompanying sketch. In placing the concrete, two guns were started from the center of the tunnel and worked outwardly toward the adits, so that carpenters could be placing the forms ready for "shooting" over the gun as it moved slowly backward. The discharge pipe was hung to the roof of the tunnel timbers, and the arch forms were then constructed, the key forms at the top being omitted at first, and put in in five-foot sections as the discharge pipe was removed.

All concrete was mixed in a plant on the surface and sent by gravity through a twelve-inch wrought-iron pipe to cars in the tunnel. From here it was brought to the heading in trains of three cars, each of twenty cubic feet capacity. The entire load was dumped into the barrel of the gun from an overhead track.

It was found that the quantity of air required depended on the length of the discharge pipe and the condition of the concrete. A dry mix needed fully twice as much air as a wet mix, but as long as the gun was never more than two hundred feet from the forms, an air compressor capable of handling five hundred cubic feet of free air a minute was large enough.

One of the reasons for the speed with which this concreting job was finished lies in the long bends used in the five-inch discharge line which lifted the concrete from the gun to the arch, and the elimination of horizontal angles. At best, the pipes were rapidly worn through by the abrasive action of the sand. It was found that pipe bent on a ten-foot radius gave the best results with the least wear to the metal, and that scouring action was reduced by using river gravel which would pass a 1½-inch screen.

Wing-Shaped Fuselage Helps to Lift Plane

NEARLY as broad as a barge, the fuselage of the Remington-Burnelli biplane, which has been flown at Curtiss field, carries thirty-two passengers. The machine was designed for cross-country passenger service. It has a wing spread of seventy feet and is driven by two 385-horsepower Liberty motors, at a maximum speed of 110 miles an hour and with a sustained-flight ability of eight hours. The camber of the fuselage corresponds with that of the wings.

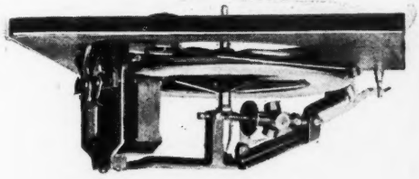
This function of the fuselage to lift as well as to hold is an engineering novelty. When a great part of the bottom wing spread is given up to a complementary wing-fuselage amidships, it means there are possibilities of "fattening" the lower wing until the whole spread is used for passenger quarters.

The peculiar wing shape of the fuselage adds to the lifting power of this plane

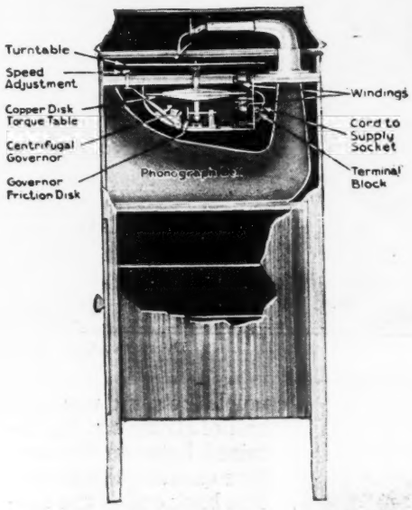
A Silent Electric Motor for Phonographs

A NOISELESS electric phonograph motor recently invented by Chester I. Hall, of Fort Wayne, Indiana, promises to solve the long-standing problem of replacing the spring motor with some sort of electrical drive.

Most electric motors produce a certain amount of noise which has been difficult to eliminate, particularly since the motor is usually suspended just above the sound-chamber. In addition to noiseless operation, an electric phonograph motor must have a high starting torque to get the record up to speed quickly and a constant speed through a wide variation of load, due to difference in sounds.



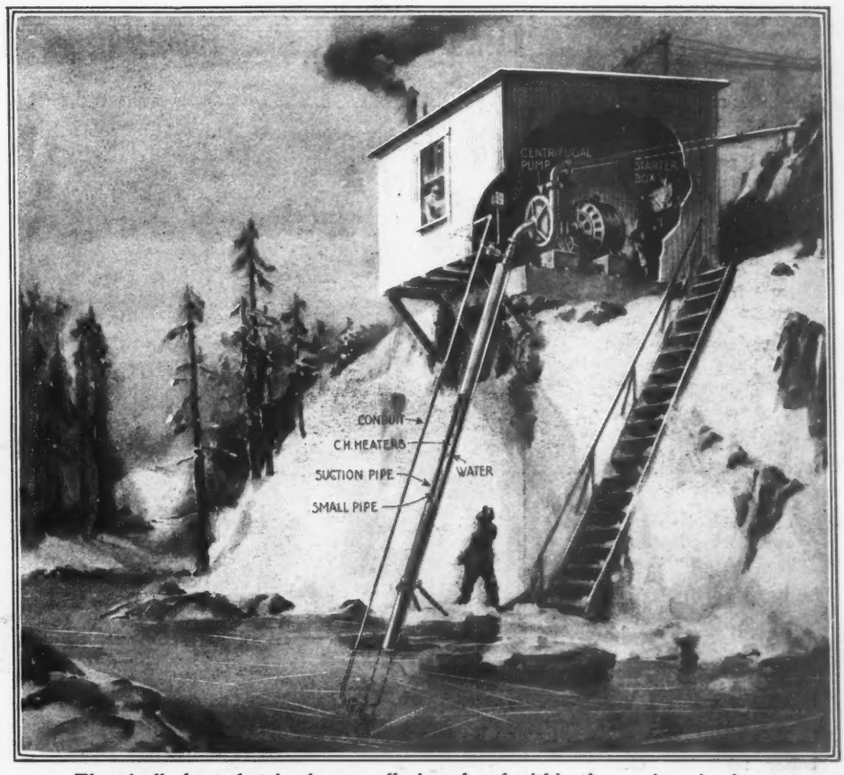
The motor at the left drives the turntable without noise



The electric motor takes up less space than the spring motor found in most phonographs

The new motor, which is said to meet these exacting requirements, is of the induction type, similar in many ways to those used in watt-hour meters. It consists of a rotating element fastened to the shaft of the turntable and running between two field coils. The rotor is formed of a ring of copper of about six inches inside diameter and one and a half inches width supported from the main shaft by a cast-aluminum spider.

The noise produced by the magnetic hum of the alternating current is deadened by suspending the motor mechanism from the board on special brackets.



Electrically heated strips in a small pipe placed within the suction pipe keep the pumping plant going throughout the severest winter weather

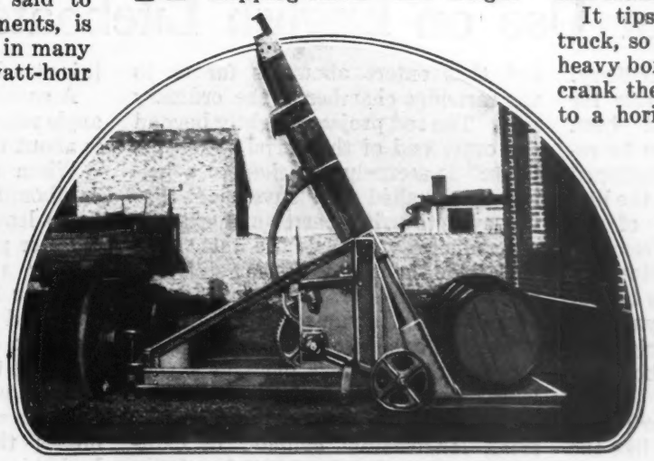
Pipes Thawed from the Inside

FOUR times in thirty-six hours the operator was compelled to thaw out the suction end of this isolated pump with a gasoline blowtorch. Variations of river level made it impractical to insulate the pipe on the outside, and as the pump was operated only ten minutes in each hour, the water was continually freezing. If the pumpman had not been a chap of considerable ingenuity, he would have spent most of the winter on the cold, slippery river-bank warming up the intake.

Instead, he overcame the difficulty with a section of unused pipe and four electric heaters. The heaters were wired together in series and enclosed in a section of galvanized pipe, held in place in the interior with fine sand. This pipe in turn was enclosed in the suction pipe, and wired to the lighting circuit through a conduit, all joints being watertight. Whenever the pump stopped, the operator cut in the electric heaters. There was no further trouble or delay with a frozen suction pipe.

Hand Truck also Acts as Elevator

THIS one-man hand truck, for use in shipping-offices and freight-stations, makes possible conveying and loading in one operation.



After placing the truck under the load, the platform is raised to a horizontal position and the barrel is rolled

It tips up like the ordinary hand truck, so that it may be shoved under heavy boxes, bales, or barrels. A hand crank then elevates the load platform to a horizontal position. The truck is moved on ball-bearing wheels to the vehicle into which the load is to be placed.

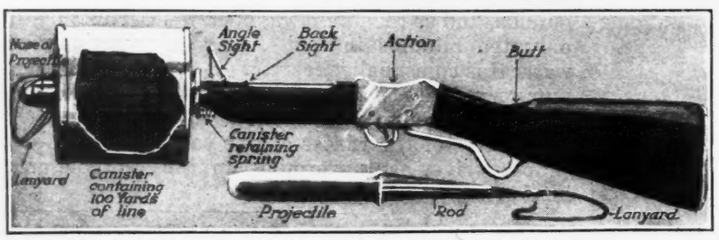
Some vehicles are higher than the truck platform when at the horizontal position. To avoid the arduous work of pushing the load uphill, as well as to permit of loading the vehicle in "layers," either on the level or downhill, another hand crank elevates the entire loading platform.

Life-lines are usually fired from shore by small cannons. This shoulder rifle makes it possible to throw a line from lifeboats. It already has to its credit a rescue two hundred and forty feet from shore

With its front and rear sights, its standard shoulder butt, and the usual trigger action, the rescue line-throwing gun shown below resembles closely an ordinary rifle. The several parts are so designed that in case of damage they can be removed instantly and new parts replaced

© Modern Publishing Co.

Drawing by G. H. Davis



Line-Throwing Rifle Adopted for Use on English Lifeboats

IN the past, during time of storm, when called upon to pass a life-line from the beach to a foundering vessel not far from shore, life-savers along the English coast have used the conventional life-line mortar. In reality this mortar is nothing more than a squat cannon of modified design, and when firing it the men employed the methods and usually the discipline of the artillery.

An ingenious light-weight rifle for throwing life-lines has just been adopted by English life-savers to replace the awkward mortar. Equipped with this simplified apparatus, the life-saver now has the mobility of the sharpshooter. He can fire it from the shore, climb with it to a treetop, or, when necessary, carry it in the bow of the lifeboat to within a few yards of the stricken ship. Indeed, originally it was intended that the gun should be used in this last way.

Essentially the gun is similar to the British short service rifle, and like the rifle it is only three feet long over all. Fitting into the barrel is a projectile rod that enters about as far as to the cartridge chamber of the ordinary rifle. The rod projects slightly beyond the outer end of the barrel, where its "nose" is securely attached to a hollow tube, called the "envelope," that fits over the rifle barrel and extends about halfway back to the butt.

Outside the tube is the canister containing the life-line. The canister consists of a thin galvanized steel cylinder seven and one-quarter inches in diameter, and seven and one-half inches long, with closed ends, or lids, stiffened by wooden disks. In the middle is a small longitudinal cylinder of cardboard, called the "becket," forming a core to the life-line, which is wound in much the same way as a ball of string and is contained between the canister case and the becket. The back end of the canister is riveted to a shaped bush round the rifle barrel, the bush itself being secured to the rifle by a strong steel tension spring. To the back end of the envelope tube a halyard is secured, which passes forward beyond the muzzle, where it is attached to the end of the life-line.

A special sight is provided for high-angle range, as the average firing angle is about thirty degrees.

When all is ready for firing, the cardboard becket is pulled right out so as to leave the coiled life-line in the canister perfectly free to uncoil. The gunner then lifts the rifle to his shoulder in the usual manner, takes aim, and fires. The projectile rod is shot out, taking with it, of course, the envelope tube and halyard. The last, in turn, pulls the life-line after it.

In case the operator of the gun misses the wrecked vessel, another becket and ball of life-line can rapidly be inserted in the canister.

Is It Really Safe to Junk Our Battleships?

Expert reveals new problems of naval policy confronting America on eve of disarmament conference

By Graser Schornstheimer

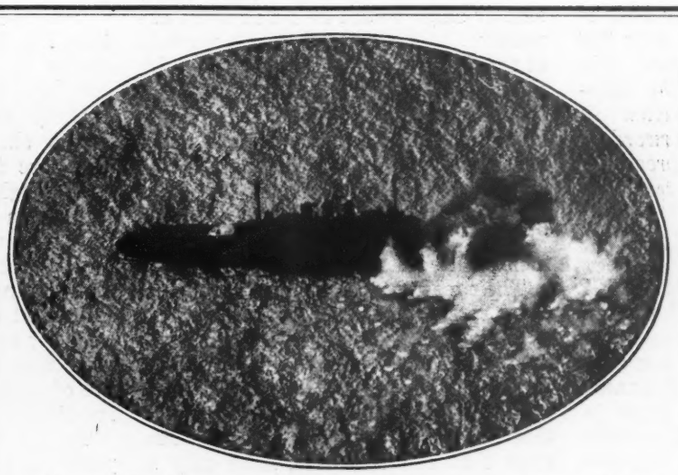
WHAT are the real lessons of the famous bombing tests off the Virginia Capes, when the *Oestfriesland* was sunk by air bombs?

Did these tests actually prove, as we have been repeatedly told ever since, that the battleship's day is over—that we can junk our dreadnaughts and protect our shores with fleets of aerial bombers?

Unless he realizes the battleship's true rôle in the next war, no American citizen can follow with understanding or interest the international conference for limiting armaments, which is about to meet in Washington.

Because of the highly spectacular phases of the airplanes' attacks on former German warships, and because of the confusing newspaper reports at the time, the actual facts and conclusions established by official investigation have been lost sight of completely. The public has been inclined to say, "Well, it's all over with the battleship," and to fall back into a mood of false security. For example, I have lately been informed with every show of sincerity that the old German dreadnaught *Oestfriesland* was sent to the bottom after being bombed for only twenty minutes. The fact is that this weakened, motionless, undefended hulk withstood the attacks of the bomb-dropping airplanes for nearly two days.

How accurate have been the current reports concerning other phases of the various tests can be judged by comparison with the following facts, which have now been officially established. The real purpose of the early experiments with the radio-controlled *Iowa* were, first of all, to make possible the computation of probable hits by aircraft bombs discharged at battle ranges. The *Iowa* was steered by wireless from the battleship *Ohio*, and during the bombing it zigzagged with no one aboard in approximately the manner prescribed for submarine attack, although at only four and a half of the available nine knots of speed. A total of eighty dummy bombs of various sizes were dropped, but only two hits scored.



This large bomb, exploding near the forward turret of the *Oestfriesland*, failed to pierce the deck and did practically no damage to the interior of the turret

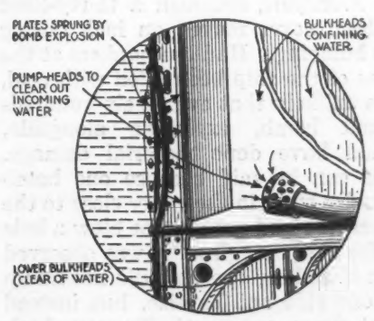
Planes or Battleships—Which?

CAN America take a short cut to naval supremacy? Shall we now stop building $45,000,000 battleships and build $20,000 airplanes instead?

Ever since the famous sham battles off the Virginia Capes, between bombing planes and old war-ships, this problem has kept public thought at white heat.

Now that we are on the verge of the Washington Conference on the Limitation of Armaments, the question becomes of even more vital significance to every thinking man in America.

This article, by a naval expert of high standing, giving one of the most informative analyses yet published of the actual results of the bombing tests, apparently proves that to maintain our position we must keep on building even costlier battleships—and that a huge aviation bill must be added instead of substituted


PLATES SPRUNG BY BOMB EXPLOSION
BULKHEADS CONFINING WATER
PUMP-HEADS TO CLEAR OUT INCOMING WATER
LOWER BULKHEADS (CLEAR OF WATER)

Showing how water, seeping into bulkheads through seams opened by exploding bombs, is checked by pumps

On the conclusion of this test the airmen declared that heavier bombs would have been more accurate than the ones used. But the velocity of the bombs dropped at the *Iowa* was little more than four hundred feet a second, and at this speed even a slight wind would affect their course. A larger bomb dropped at the same height would be more affected by the wind, because a greater surface would be acted upon.

So far as air conditions were concerned, the airplanes undeniably had the better of it. The weather was ideal. Again, the *Iowa* had the disadvantage of steaming at only four and a half knots. And, finally, while the airplanes were acting offensively and under perfect conditions, the ship was necessarily without the services of its anti-aircraft guns.

Assuredly if these guns had been barking defiance at the bombers, the final score would have been even less creditable to the airmen, for the two lone hits were made from an altitude of about four thousand feet, and it is the claim of experienced anti-aircraft experts of the United States Ordnance Bureau that they can quite regularly shoot down airplanes flying into the bombing area over their ships from any height up to six thousand feet. The airmen deny this, but it is a fact that no bombing attack against a resisting battleship has ever scored a direct hit. On the other hand, British dreadnaughts in the Dardanelles shot down a number of attacking planes.

The second of these more important tests was conducted against the light cruiser *Frankfurt*. This was a very lightly built ship, and the planes would have sunk it after a few moments of active bombing had they justified the confidence expressed in them in the days before the tests.

(*Continued on page 28*)

First Picture of Japan's New Super-Dreadnaughts,

The following exclusive description of the Japanese battleships, about which there has been so much said in news despatches, has particular interest in connection with the accompanying article on the bombing-tests. It forecasts the type of future dreadnaughts with which bombing-planes would actually have to cope, instead of with the older type that they sank off the Virginia Capes. The picture, moreover, portrays the enormously costly naval construction in which the Powers will henceforward be forced to compete, unless the approaching international conference really results in a limitation of armaments.

By Wilfred S. Ogden

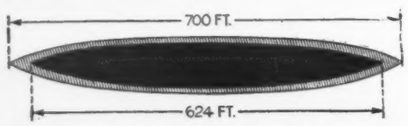
POPULAR SCIENCE MONTHLY publishes herewith the first picture of one of the two largest and most powerful war-ships the world has ever known. They are the new Japanese battleships *Kaga* and *Tosa*. Built in the private dockyards of the Kawasaki Company at Kobe and of the Mitsubishi Company at Nagasaki, these naval monsters—being launched this fall—are units of Japan's 1918-1919 naval program.

When completed, they will cost well around $40,000,000 each. In the United States, with higher labor costs, similar ships would be much more expensive. The normal displacements of the *Kaga* and *Tosa* are stated to be about 41,800 tons, as against 32,600 tons for the United States ship *Maryland*, and 41,200 tons for the British battle cruiser *Hood*. The length is 700 feet and the beam about 104 feet, normal, and 108 feet outside the "blisters." The full load displacement will be close to 48,000 tons.

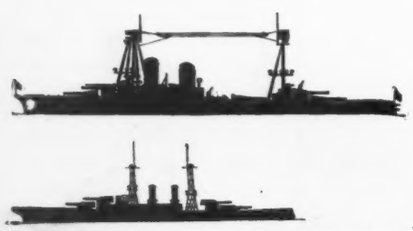
Their main batteries fire a broadside of no less than 24,600 pounds a ship, as against 16,784 pounds for the *Maryland*, and 15,600 pounds for the *Hood*. During the battle of Jutland the Germans were able to make quick work of three modern battle cruisers. The guns that did the work fired only a 900-pound shell. In the United States bombing tests this summer, it took two days for bombs weighing from 600 to 2000 pounds to sink a non-resisting, non-maneuvering war-ship. What could the *Kaga* and *Tosa* do in that time with their great battery power?

Ten 16-inch guns, mounted two in a turret in five turrets mounted on the center of the ship, form the main battery. They are 45 calibers long, of entirely Japanese manufacture, and fire a shell weighing 2460 pounds. Compare this shell with our 16-inch shell weighing 2098 pounds. A platform from which a small, fast airplane can be launched is on the crown of the highest forward turret. The plane is for spotting long-range shellfire. It is estimated that this spotting will give a 25 per cent greater hitting efficiency than was the average in 1914. The fire of these ships can be controlled at six different points.

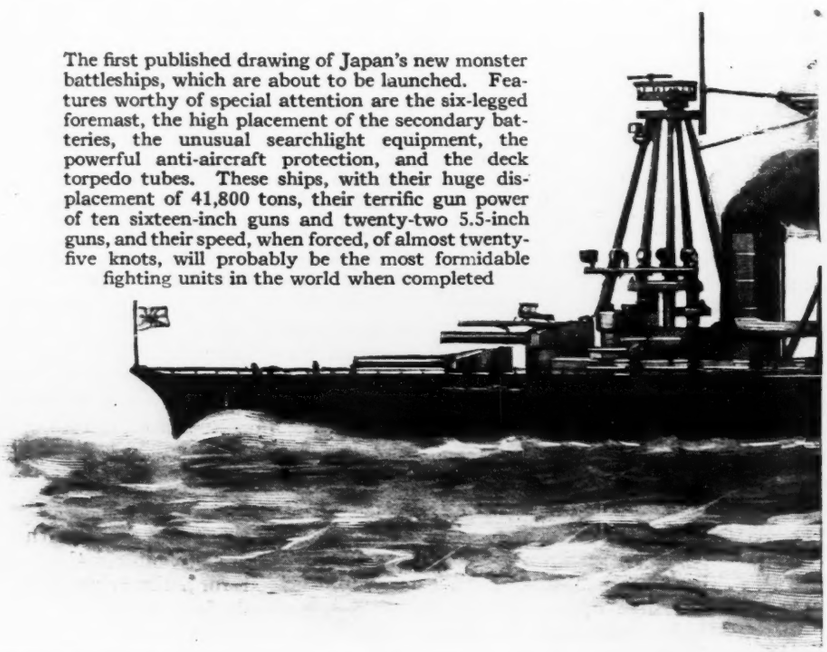
To get a good idea of the battery power of the Japanese ships, consider



The cross-hatched outline illustrates the superiority in size of the *Tosa* over the *Maryland*, indicated by the solid black section.



The length of these drawings indicates the difference in tonnage between ships of the *Tosa* class and the latest United States ships. The normal displacement of the Japanese ships is 41,800 tons compared with the 32,600 tons of the *Maryland*, one of the latest electrically driven United States fighting-ships



The first published drawing of Japan's new monster battleships, which are about to be launched. Features worthy of special attention are the six-legged foremast, the high placement of the secondary batteries, the unusual searchlight equipment, the powerful anti-aircraft protection, and the deck torpedo tubes. These ships, with their huge displacement of 41,800 tons, their terrific gun power of ten sixteen-inch guns and twenty-two 5.5-inch guns, and their speed, when forced, of almost twenty-five knots, will probably be the most formidable fighting units in the world when completed

(*Continued from preceding page*)

Bombs weighing up to six hundred pounds were used against this thinly armored craft. During the morning, however, the attacks were with smaller bombs; and it was found that projectiles weighing up to three hundred pounds failed to inflict serious damage, even when striking flat upon the decks. Five of the smaller bombs that struck the *Frankfurt* were "duds," yet six others did explode, and, though they tore up the superstructure, they failed to pierce the vitals. No less than seventy-eight bombs were dropped, at altitudes under four thousand feet.

In considering the results of this test, it must be remembered that the *Frankfurt*, although a thirty-knot cruiser, never moved an inch during the bombing. Had the bunkers at the sides of the ship been filled with coal, it is unlikely that even a six-hundred-pound bomb, exploding alongside, would have done material damage. This can be said because one bomb actually burst in the water close to the forecastle, and yet did not blow a hole in the side. As proof it was observed that in sinking the ship did not fill up on one side and capsize, but instead went down on practically even keel. The bomb that broke the ship's back landed close alongside the fo'c'sle, where the submerged torpedo tubes weaken the back. The structural weakness caused by the submerged tube has led the British to exclude them in their future ships, and similar structural modifications will undoubtedly be made if the bombing plane ever becomes a menace.

Could Have Floated for Days

To repeat: during the entire test the vitals of the ship were not damaged and the decks were not pierced. In actual combat, of course, the engines would have been running, and as fast as bulkheads were strained, the pumps

Naval Monsters which Surpass America's Mightiest

the performance of the planes in the *Iowa* test—two hits out of more than eighty bombs dropped from an altitude of 4000 feet. These bombs had a velocity of from 300 to 400 feet a second, according to the timing done aboard the destroyers, and so failed to pierce the armored deck of the *Oestfriesland*. The Japanese 16-inch gun fires a 2460-pound shell at a rate of about 2700 feet a second, that will pierce 12 inches of armor at a range of about 12 miles, and at least 10 per cent of the shots fired will be hits. Whereas the planes bombed the *Iowa* for a whole day, achieving only two hits out of eighty bombs fired, Japan's world-beating war-ships could fire 900 shots an hour and ninety of them would hit and pierce a 12-inch belt at a range of 12 miles.

The secondary battery of the *Kaga* and the *Tosa*, consisting of 22 fifty-caliber 5.5-inch guns, is mounted unusually high on the sides of the ships. This distinctive feature will make them available in almost any kind of weather.

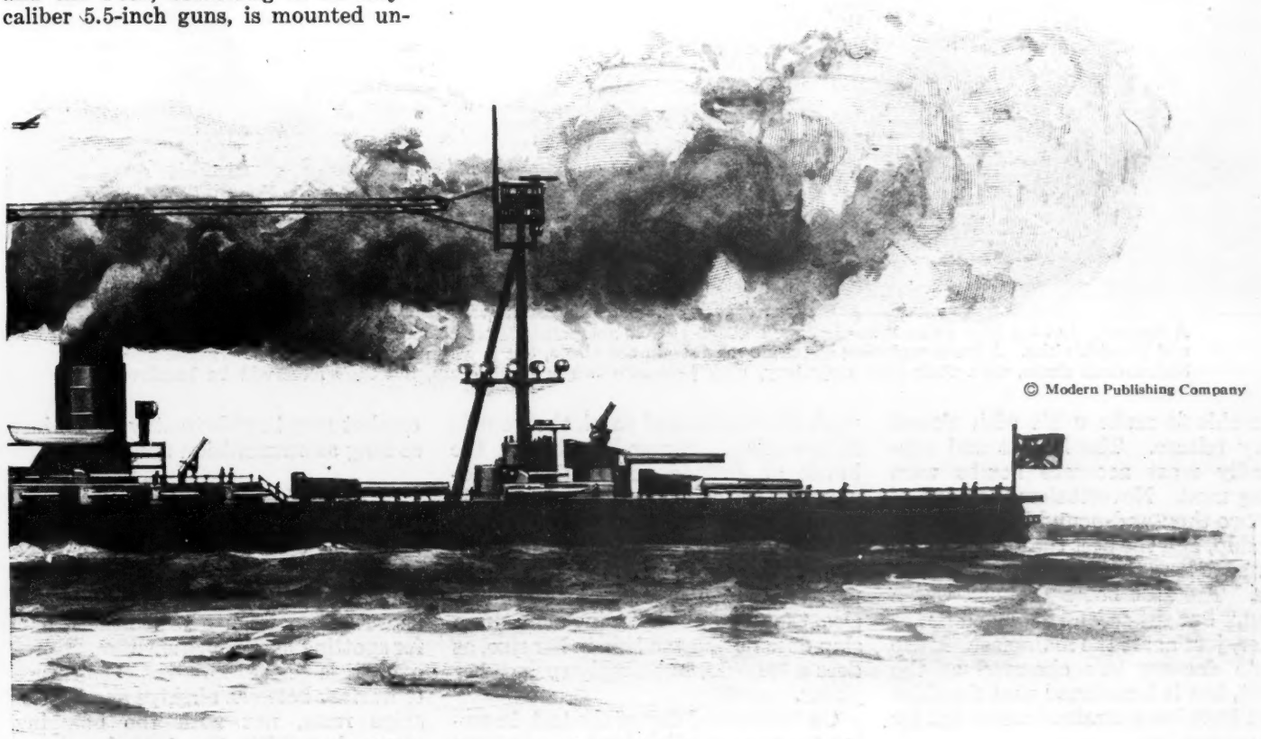
For the defense against aircraft, each ship carries 4 three-inch, fifty-caliber anti-aircraft guns on special high-angle mounts. The torpedo armament consists of four deck and four submerged 21-inch torpedo tubes.

Immense British-built turbines will drive these ships at a normal speed of 23 knots. When these engines are forced, it is said that the ships will be able to make 24.5 knots. Because of the scarcity of oil in Japan, the ships are equipped to burn coal as well as oil.

The Japanese are placing a total of seven inches of deck protection on several levels in these ships. The first deck, three inches thick, would be pierced by a shell, but the second deck, together with the ship's armored bulkheads, would localize the effect of the explosion. The ships have a 12-inch armored belt, and the turrets are protected with 16-inch armor.

Below the water is the "blister" protection. This arrangement is a duplicate of that evolved by the British during the war. It was designed to offset the effects of mines and torpedoes. The protective bulkheads, for defense against submarine explosions, can also be used as fuel-oil tanks. This is one of the features that gives these ships their great cruising radius.

When complete, the ships will have a complement of about sixteen hundred officers and men.



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would have prevented the water rising in the affected compartments. In all probability the ship could have been kept afloat for hours, or even days, longer than it was.

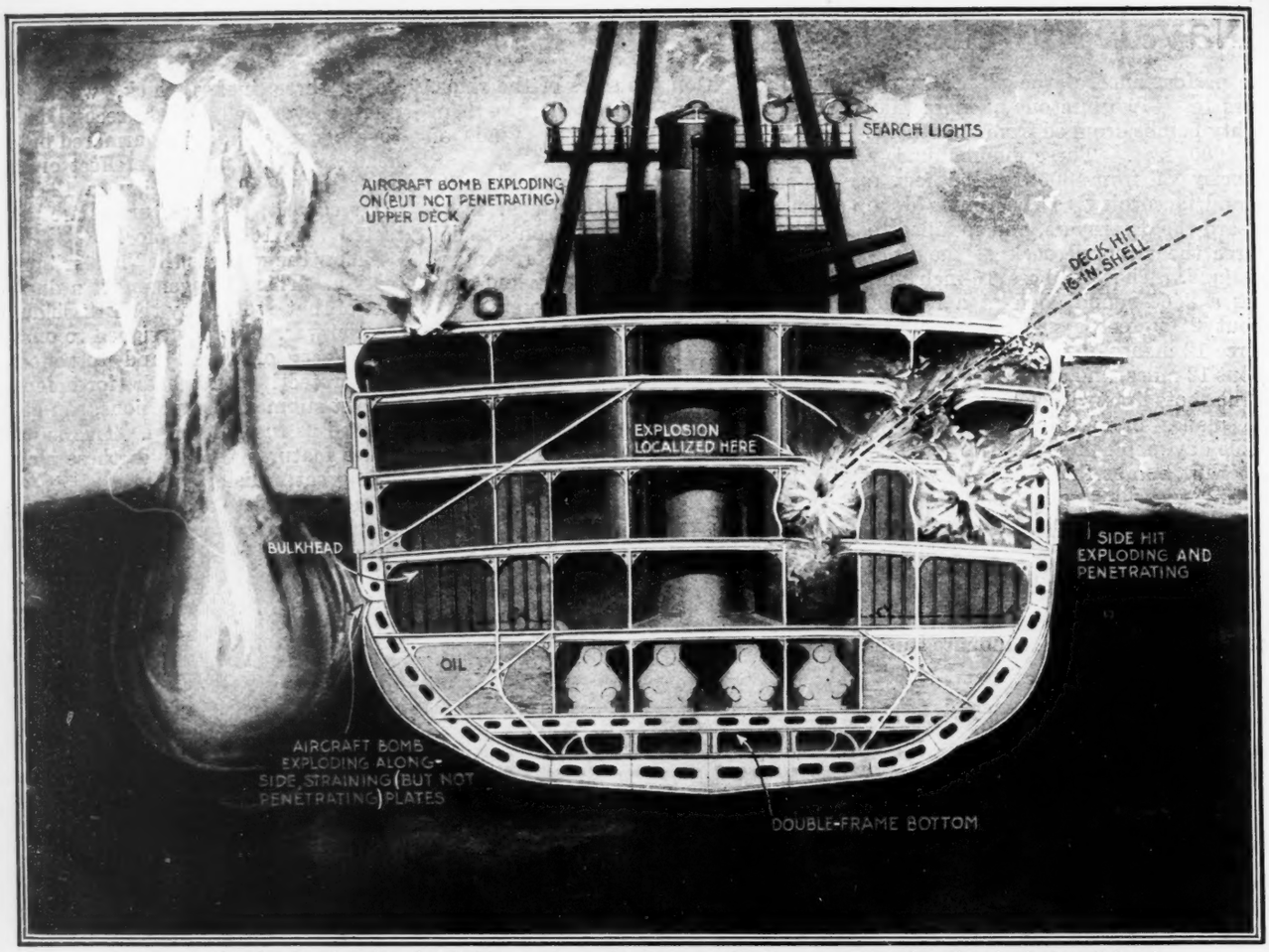
When we take up the most spectacular of all the tests, the bombing of the former German dreadnaught *Oestfriesland*, we are apt to forget that it took nearly two days to sink her, under almost perfect conditions. During the first day fifty-two bombs were dropped at low altitudes, of which thirteen were direct hits, although but four exploded. One of the explosive hits was directly in front of the forward twelve-inch-gun turret. The airplane enthusiasts have claimed that even should bombs fail to pierce the decks of a war-ship, the concussion would kill every one in the vicinity. Yet, although one entire side of this forward turret had been removed for ballistic tests, the interior was in no way damaged. Decided damage was done, however, by bombs that exploded alongside the ship and near the areas where armor had previously been removed for experimental purposes. A number of small leaks, which on a fully manned battleship in action could have been repaired quickly, were visible on investigation after the first day's bombing.

The next morning, it was ascertained that the stern had gone down two feet, and that the engine-rooms and a number of compartments were flooded.

No Direct Hits Made

The bombing recommenced, this time with the heaviest obtainable bombs. By noon the airmen were working at a range of slightly less than three thousand feet. At this height, utterly unhampered by the anti-aircraft gunners, who in action would put a fierce barrage in the bombing area over the ship, the planes ought to have

(Concluded on page 30)


SEARCH LIGHTS
AIRCRAFT BOMB EXPLODING ON (BUT NOT PENETRATING) UPPER DECK
DECK HIT 16-IN. SHELL
EXPLOSION LOCALIZED HERE
BULKHEAD
SIDE HIT EXPLODING AND PENETRATING
OIL
AIRCRAFT BOMB EXPLODING ALONGSIDE, STRAINING (BUT NOT PENETRATING) PLATES
DOUBLE-FRAME BOTTOM

A diagram showing how modern battleships, such as the Japanese *Kaga*, are protected against both aircraft bombs and broadside hits. A bomb exploding alongside may strain the plates, but it will not actually blow a hole in the side. Sixteen-inch shells, with their high trajectory, may penetrate one or more decks, but their force will be localized

been able to make a hit with almost every release. The largest and supposedly most accurate bombs were being used. Nevertheless, not one of the two thousand-pound bombs struck the ship, and the best the airmen could do was to land them in the water alongside. The first bomb dropped was a "dud," but the second exploded in the water, just abaft the mainmast. Little or no damage was observed as the result, but it is assumed that the sides must have been strained somewhat by the concussion.

At this point, too, it may well be remarked that the *Oestfriesland* was known to have been weakened during the latter part of the war. It suffered from a mining experience during the battle of Jutland, and was badly damaged by the crew prior to its surrender to the British. Parts of her armor and machinery had been removed in the United States also, and as a result of the bombing of the day before the vessel was really in a precarious condition.

Sunk after Two Days

Dangerous as this condition was, the ship could have been kept afloat indefinitely if there had been a crew to work the pumps and patch the wounds in her sides. Remember that in the battle of Jutland the British dreadnaught *Marlborough*, with a huge hole torpedoed in its side, was not only kept in line, but was fought until the end of the action, when it proceeded to port under its own steam. Remember, also, that a bomb exploding alongside a ship does not blow a hole in her side, as does a torpedo, but simply springs her plates.

On the second day of the test, knowing that the *Oestfriesland* was leaking badly at the stern, the airmen dropped a bomb only a few yards from the propellers. This was the bomb which General Williams declared was "heard around the world." A veritable mountain of water shot upward and swamped the stern of the vessel. The hull shook with the impact, and when the water receded it was seen that the stern was sinking rapidly.

Thus it was that the *Oestfriesland* resisted for nearly two days the most powerful bombs and most experienced bombers in the American service. The actual results of the test show, not, as generally reported, that the battleship is useless and ready to be scrapped, but that a ship of its type can withstand a fearful pounding, and in actual combat may be able to stay afloat just so long as ammunition and fuel last.

Airplane Still Essential

But the tests did not prove that the airplane should be scrapped, either. Thus the scouting plane is valuable for short reconnaissance expeditions, and for spotting long-range shellfire. Moreover, it is certain now that the future of warfare between airships and battleships rests, not with the bombing plane, but with the torpedo plane. And the trouble here rests at present with the torpedo and not with the plane. The torpedo is always likely to be erratic. When dropped from any considerable height into the water it is necessarily made more so by the impact of its landing. But let somebody invent a method of guiding torpedoes from the plane that launches them, and we shall see the battleship harder pressed to maintain its supremacy than it has yet been. As an indication that the torpedo plane is soon to displace the bombing plane, it can be noted that the British have already removed all the bombers from their great aircraft carriers and have replaced them with "cuckoo" torpedo-dropping planes.

Telegraph Cable Laid by Airplane

A SUCCESSFUL attempt was made recently in Sweden to lay telegraph and telephone wires from an airplane. Ten kilometers, or slightly over six miles, of cable was laid between two stations separated by woods and rough country. Telegraph communication was established in the incredible time of eight minutes, six of which were consumed in laying the cable.

This new application of the airplane is of vast civil, military, and naval importance, particularly in districts having little if any means of communication, or over terrain difficult of access.

The apparatus used in the tests was simple, light in weight, requiring small space, and it could be installed readily in any machine. The wire container was located in the pilot's cockpit. Attached to the wire as it was dropped were small weights with signal flags. A device was provided for cutting the wires after the work was completed.

In tests, it was found possible to lay cable at a flying rate of over 150 miles an hour.

Airplane lays army cable across country at a speed of two miles a minute with signal flags indicating the location of the wire

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THERE is little or no oil in oil-shales. The shale must be mined and crushed, then heated in closed retorts. The distillation breaks down the components of the shale into ammonia, gas, and a crude oil. The United States has important oil-shale deposits in the West, but much money and research will be required to develop an oil-shale industry, to the point where it will increase our oil supply.

College Teaches Ideal Farm Layouts with Model Homestead

THE Nebraska College of Agriculture has constructed a model farmstead to teach its students the proper relation and arrangement of farm buildings. The plan has been tried with great success on farms in several counties of Nebraska. In the model, the various buildings have been laid out so that the farmer walks around the circle in doing his chores, never retracing his steps. The path he follows is shown by the dotted line. It is a well-known fact that the average farmer thinks of wasted motion only in relation to his machinery, never in relation to his own motions.

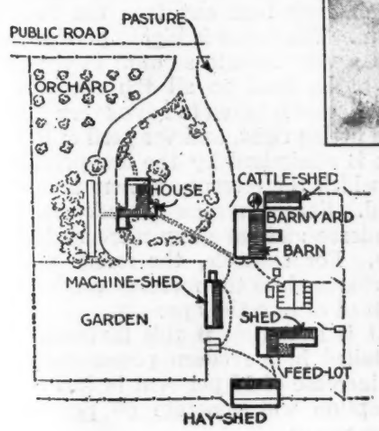
Many other points were given consideration in planning the farmstead to make it practical and at the same time comfortable and pleasant. For instance, the barns and yards are located east of the house so that all unpleasant odors are carried away by the wind which, in the territory for which this farm was designed, usually is south and southwest in summer, and north and northwest in winter. The house itself, moreover, is located on high, well-drained land, insuring a good view and preventing barnyard drainage from reaching it.

All of the buildings are located to act as wind-breaks to adjoining yards, and nearly all the fences serve two yards. The yards are adjacent to the pastures and the garden close to the house. The farm scales are situated so as to be handy for weighing grain and stock, and it is possible to drive to nearly all of the buildings without opening gates.

In locating the barn it was considered that buildings situated in the sun but with breezes blowing through them in summer are cooler and more comfortable than those in the shade but with no breezes. Hence the barn has a central alley running through it from north to south, and the building is cool even in very hot weather.

The college works on the theory that every farm is a factory, and that as such it will be improved by applying the principles of scientific management. The model is to show the coming generation of farmers how to avoid many of the unnecessary nuisances which their fathers had to contend with or which they accepted as part of the drudgery of farm work.

Such a scientific arrangement of farm buildings as shown here lightens the drudgery of chores and is one means of encouraging boys to stay on the farm



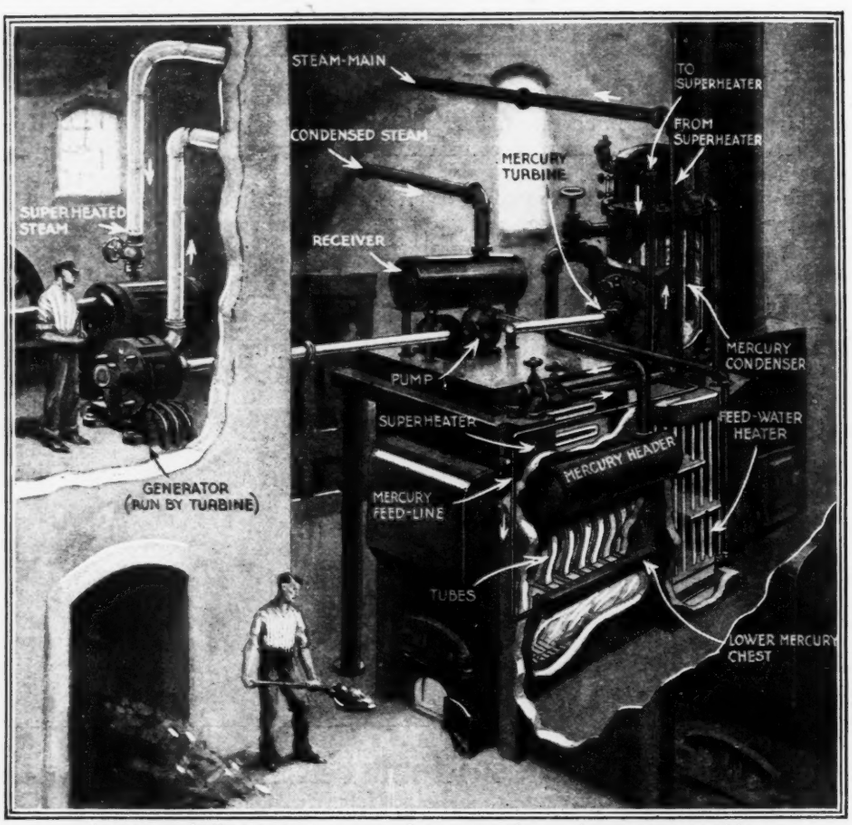
Metallic Steam to Increase Central Station Efficiency

Unique boiler, using mercury instead of water, forecasts radical changes in power-house design

A DISTINCT departure from long established power-plant practice has been made by W. R. L. Emmet in his mercury boiler, which generates mercury vapor instead of steam for turbine and steam-engine propulsion.

The efficiency of any heat engine depends upon the range of temperature through which it works—that is, the difference between the temperature of the steam in the boiler and that of the water in the condenser. But power-plant engineers have been hampered by the fact that the normal temperature range of water is very small, extending from 212° F. to 101° F., when a twenty-eight-inch vacuum condenser is used. While this range can be increased somewhat by superheaters, their application is limited by properties of steam, for at high temperatures steam pressure becomes too great for commercial operation. To overcome this difficulty Mr. Emmet evolved a plan which called for the use of mercury instead of water in the boilers.

Mercury boils and condenses exactly like water, except that its density is much greater and its boiling-point higher. At atmospheric pressure it boils at 677° F. and condenses in a twenty-eight-inch vacuum at 455 degrees. This gives a temperature drop of 222 degrees—almost twice that of water, and the high temperature of the condensate permits the use of an independent supplementary steam plant in addition to the mercury system.



A mercury boiler generates vapor for two engines—the mercury turbine and a steam plant operated by the heat developed in condensing the mercury vapor. Because of the specific heat of mercury as compared with steam, the effective temperature range is doubled

Special Boiler Used

In the Emmet engine mercury is heated in a boiler similar in principle to the ordinary steam-boiler, and the vapor produced is used to run a turbine. The exhaust from the turbine is condensed in a surface condenser of special design, which also acts as a boiler. The heat given out by the mercury as it liquefies makes steam of the cooling water, and this steam is used either to drive another turbine or to operate the heating plant of the factory.

The great cost of mercury and the high temperature of the vapor necessitate many minor changes in the design of the boiler. Flattened boiler tubes are used in order that the maximum heating surface might be obtained for the minimum amount of mercury. The products of combustion from the furnace pass upward through part of the tubes, and then forward among the remainder. The mercury drains to the lower mercury chest, passes through the tubes, and reaches the mercury header, corresponding to the steam drum, at about ten-pound gage pressure. From this point it is led to the turbine.

Owing to the high density and low spouting velocity of the metallic steam, the turbine may be a single stage machine with short buckets, and run at a low speed.

From the turbine the mercury-vapor passes to the combined condenser and water-boiler. This consists of a tank with a steam-drum at the top. A number of straight tubes extend from the steam-drum into the condenser, and the mercury is condensed on the surface of these tubes. As the boiling-point of mercury in a twenty-eight-inch vacuum is 455° F., steam is generated inside the tubes, circulates through smaller tubes placed in the interior of the steam-drum, from which it is conducted through pipes to the steam-superheater and finally passes through the steam-main to the engine where the steam is used. From this point it returns to the feed-water heater, which is really an economizer, placed directly below the mercury condenser. From the feed-water heater the water returns to the condenser-boiler, and so completes the cycle.

The mercury condensate is drained directly back to the lower mercury chest, since its high density renders a feed-pump unnecessary. By setting the condenser above the boiler, the latter may be fed by gravity.

Leakage Peril Minimized

The chief drawback to the universal use of this machine—and aside from the cost of mercury needed—lies in the danger that some of the mercury vapor may leak out into the boiler room. The vapor is highly poisonous, and a very minute amount in the air might be fatal to all the operators. Great care is taken to have every joint and fitting tight, and the peril of leakage is minimized by the low pressure at which the mercury system is operated. Special means are adopted to condense and save any mercury leakage. For example, the safety valve discharges into the mercury condenser instead of into the open air.

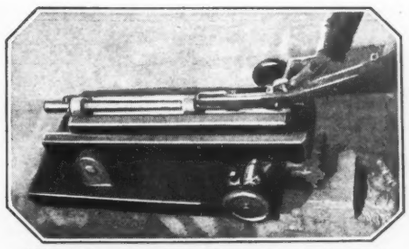
It is said that if this invention is installed in a modern power station, an increase of 15 per cent in fuel consumption will generate 66 per cent more power.

Testing the Accuracy of Ammunition with the Mann Rest

THE small boy with his rifle, the target expert, and the outdoor sportsman who appreciate alike any increase in accuracy of firearms, will be interested in the Mann rest, a device recently adopted by the United States government for the testing of ammunition.

The Mann rest does not supersede, but is used with, the machine rest that has long been in use. It consists essentially of a heavy steel block slightly longer than the rifle barrel, with a very accurately milled V, about an inch and a half deep, extending its entire length. The sides of the V are made absolutely parallel, as this is the feature on which the accuracy of the tests depend. For convenience, the block is set in the base of the ordinary machine rest, so its elevating and traversing screws can be used for the Mann rest.

The second part of the apparatus is a heavy rifle barrel of about one and one quarter inches in diameter from breech to muzzle. On this are placed two very carefully made rings, one near the muzzle, the other near the breech, about eighteen inches apart. They are most carefully made so that the distance from the center of the bore of the barrel of the gun to the outside of a ring is the same in any direction.



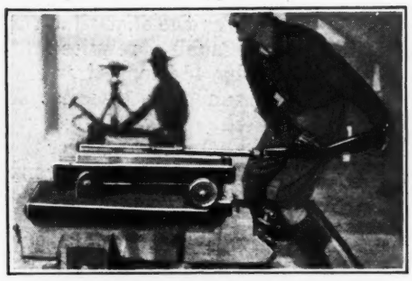
The Mann rest consists of a V-shaped groove and accurately machined rings around the rifle barrel

It is obvious that if the barrel is laid into the V cut in the block, it can be revolved on its two rings without altering the line of the bore. Likewise, as the sides of the V are cut absolutely parallel and smooth, the barrel can be pushed back and forth without altering the direction of the bore.

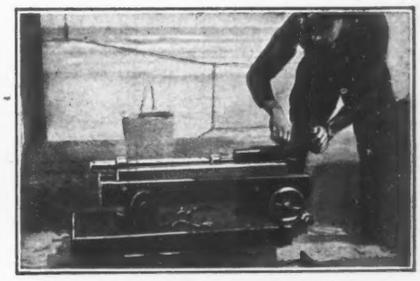
Under such conditions, it is plain that every shot fired will depart in precisely the same line, even if you take out the barrel between shots and walk around the block with it. The barrel as used in the government work is fitted to the receiver of an ordinary service rifle, and the regular bolt is used. A piece of stock is used to help check the recoil of the barrel in firing.

At recent government ammunition tests using both the Mann rest and the machine rest, the Mann rest shot several ten-shot groups at six hundred yards that could be included in a three-inch square, while dozens of the groups could be included within a six-inch circle.

The most accurate and consistent results ever obtained are to be had with this arrangement. From the ballistician's standpoint it is good, because the very heavy barrel prevents barrel vibration and the possible delivery of one shot a trifle off the line of a previous one due to some change in barrel "warp" or vibration.



The barrel rests lightly in the groove to allow free recoil after firing. It can be replaced for repeat tests



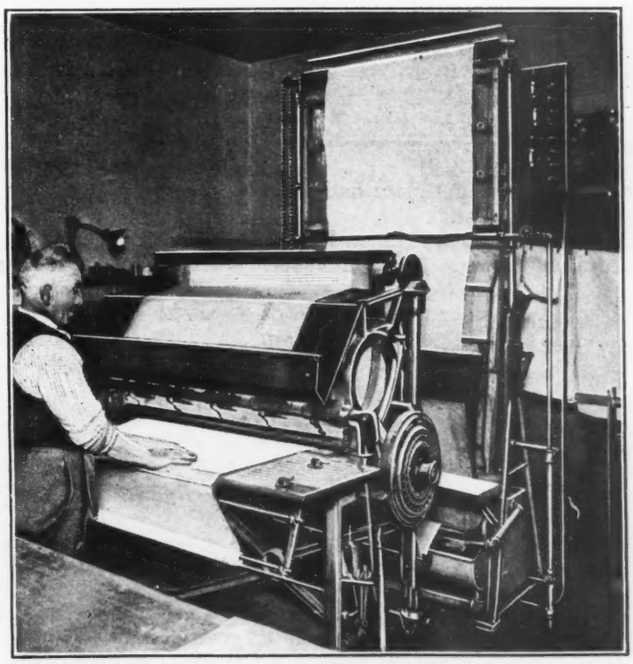
The grooved block is clamped in an ordinary machine rest, so that the rifle may be aimed as usual in testing

Continuous Machine Prints, Develops, and Dries Blueprints

CONTINUOUS printing is the latest improvement in the making of blueprints. A long strip of sensitized paper moves steadily through the machine and is printed, developed, and dried at the uniform rate of five feet a minute.

One operator can handle the apparatus. He places the tracings on the sensitized paper, which is fed from a roll and carried past a bank of arc lamps for the exposure. The exposed paper then separates from the tracings and passes through a bath of clear water and afterward through a weak solution of bichromate of potash or soda and again through clear water.

The course of the paper is then upward over the dryer and down to a winding device, which makes a loose print roll free from wrinkles and ready for trimming.



With this continuous blueprint printing, developing, and drying machine the only task of the operator is to feed in the drawings to be copied

The paper is dried uniformly under tension, thus eliminating undue shrinkage and assuring correct measurements on the final prints.

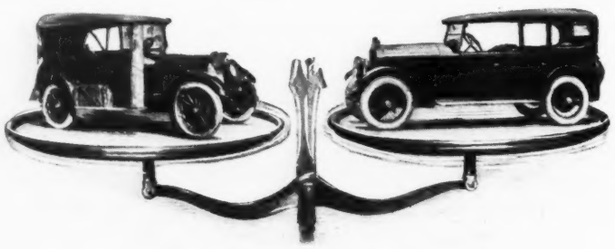
Experience has shown that the rate of three hundred feet an hour is about right for the complete process of exposing, washing, and drying. This speed is also convenient for the operator in handling the average run of tracings. Either gas or electricity may be used in the drying, only about fifty cubic feet of gas being required an hour. The heat can be regulated in accordance with the speed at which the machine is operated.

ONE cubic foot of ocean approximates sixty-four and three tenths pounds.

Why I Believe You Should Buy a Used Car

It costs less in the long run than a new model and gives greater power and riding comfort

By Harold F. Blanchard



Shall I Buy a Used Car?

Yes! by Harold F. Blanchard, automobile expert, who has bought five of them.

No! by S. P. McMinn, former editor of Motor World, *who has tried both new and old.*

YOU have a modest sum to spend and you need an automobile. Which shall it be—new car or old?

You can afford either a brand-new machine of one of the lighter makes, or you can buy a heavier, more luxurious, used model. Which shall it be?

Few questions are more frequently discussed by prospective car-owners. But, though the problem is of vital importance to us all, have you ever seen it thoroughly thrashed out in debate by experts?

Popular Science Monthly has retained two automobile experts—not interested in promoting either side of the argument—to tell the real facts of their own experience.

Every man who owns or wants to own an automobile will find these articles invaluable because of the concrete facts and figures which they present.

The Used Car is defended this month by Mr. Blanchard. Next month Mr. McMinn will argue the case for the New Car.

I AM in favor of the used car. I can get more for my money by investing it in a used car than I can by investing it in a new one. I have owned seven cars, for which I paid amounts varying from $300 to $2000. With two exceptions, I bought used cars and still feel that the used car is the better buy.

I shall be in favor of used cars until that fine day when I can dig up enough money to buy a brand new model of the best car built.

There was a day when a shiny, new car, any new car, filled me with envy. I wanted nothing more than to own one of them. Finally the day arrived when I decided that I could afford a modest machine. I decided in favor of a small, cheap, new machine, partly because tires and gasoline bills would be smaller and partly because I wanted a car that was new. I kept that car for three years, driving it through all sorts of weather. The first year I liked it very well, except that it rode rather badly and the engine ran too fast. The second year the upholstery and paint began to show signs of giving out, and many things in the car required mechanical attention. Before the third year was out, it was obviously too badly worn to do another season. The original price had been eight hundred dollars.

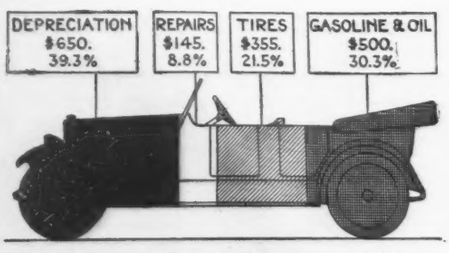
To put the car in thorough condition would cost five hundred dollars. Finally I sold it to a man for $150. Once the car was disposed of, I was able to calculate that much-disputed item—depreciation. It was $800 less $150, or $650. Other expenses incurred during the three years, in which I had covered some 30,000 miles, were: Repairs, $145; tires $355; gasoline and oil $500. There was no garage expense. The car had cost me a total of $1650 or 5½ cents a mile.

Shortly after I sold my car a neighbor suggested that I buy an old four-cylinder car that a friend had for sale. The car was in excellent shape, paint and tires included. I looked at the car and found also that the lines were not at all bad. The car appealed strongly to me because it was rugged, smooth running, and powerful—qualities that my little car had not possessed. Its reputation seemed to be fully merited, because this particular car was in better shape now than my old car had been after little more than a year's service. The one stumbling-block was the fact that the machine required 36 by 4½ inch tires and ran only 10 miles to the gallon of gasoline.

On looking over the expense figures for my first car, I remembered that the largest item was depreciation. Clearly this item was almost eliminated on the car that I was considering, for at the low price of $300, it could depreciate little further. As near as I could estimate, it was a machine that I could sell a year or two afterward for somewhere around $200. Repairs were likely to be less on this big machine than on the smaller one. These facts would largely compensate for increased cost of tires and gasoline. Also, there was the fact that I should have only $300 tied up instead of $800.

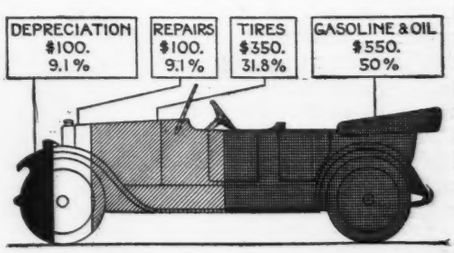
The result of all my figuring was that I bought the used car and ran it two

Small New Car



The cost of operation of a new car, graphically shown above, is based on Mr. Blanchard's actual experience with a low-priced model

Large Used Car



With Mr. Blanchard's first used car, of heavier construction, gas and oil costs showed a considerable increase, but depreciation was lower

years, or about 20,000 miles. It was a much pleasanter automobile to operate than my first; roomier, more comfortable, faster, more reliable, and it spent less time in the repair-shop.

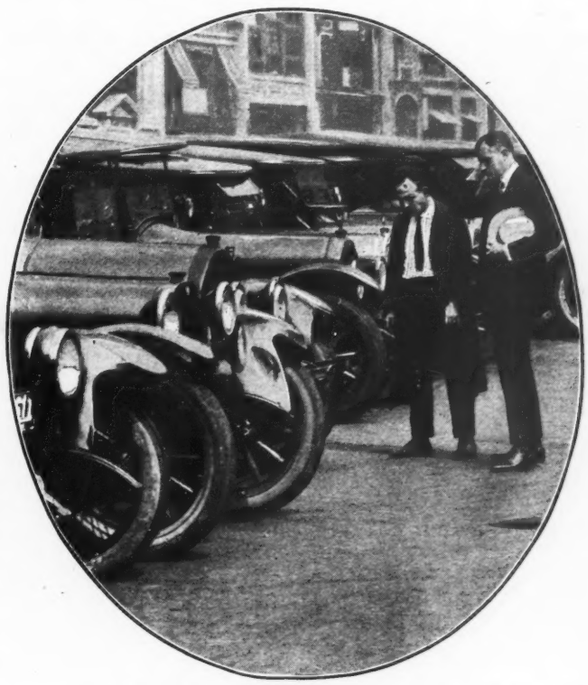
As to expense, I was not disappointed in my original estimate. At the end of two years I sold it for $200, or $100 less than I paid for it. Repairs during the two years were a trifle less than $100. Tires were $350 and gasoline $550. The total happens to be $1000, or 5 cents a mile. If proper judgment is used in selecting the right used car, there is no reason why it should cost any more to run than this big car did.

One Example of a Used Car Owned by the Writer

The car I have now cost me a little more than $1800. Just a trifle more than two years ago it was sold new to its first owner for more than double that sum. When I bought it, it had been run about 15,000 miles. The machine is so well made that the wear and tear of this amount of travel—more than halfway around the earth—has been about negligible. I expect to drive it another 20,000 miles before having it overhauled. After that, I expect that it will be good for another 30,000 or 40,000 miles before it requires a second overhauling, and that with good luck it would travel a lifetime of 200,000 miles. If I should sell the machine at any time during this long life, I should be able to get a proportionate price for the car, since its sturdy qualities are well known.

However, for argument's sake, let us say that I run it 40,000 miles in the next four years, that I spend $250 in repairs in that time and at the end of the period I sell the car for $600. The machine runs a trifle more than 10 miles to the gallon, or about 2.5 cents a mile, oil included. Gasoline and oil, therefore, will cost $1000. Tires are much better than they used to be and run 15,000 miles at a cost of $250 a set. Tires during this period may be figured at $700. Depreciation is $1200. The total is $3150, or just a little less than 8 cents a mile. This is more, it is true, than in the two preceding cases, but this car offers much more luxury. If the cost of running this fine car is compared to that of operating a new car costing $1800 over a like distance, it is found that the new car would cost more a mile. In other words, as I stated at the outset, whatever the sum invested, I prefer a used car to a new car at the same price because the used car gives me more for my money.

Why do I like this used car better than I would any new $1800 machine? For one thing, the car that I have is more comfortable. The cushions are deeper and softer, and the backs of the seats are so rounded that they fit the back better. There is more leg room, too. The machine rides better on rough roads.



Shall it be Good Appearance and Expense, or Comfortable Riding and Economy? That is the question to be settled in the problem of New Car *versus* Used Car

My car possesses many small but important conveniences that the cheaper new machine has not. There are roomy compartments; there is a full set of tools—standard equipment with this car—with a powerful jack and a pump that works like a charm. I can manipulate with unusual ease the wind-shield clamps, door-handles, and other fittings. The doors are perfectly fitted. In fact, everything about the car betokens the highest grade of workmanship.

The brakes are powerful, long wearing, and exceptionally easy to operate. The steering is surprisingly easy. The wheel may be manipulated with one finger. Electrical connections also are unusually substantial, and the lights are always in working order.

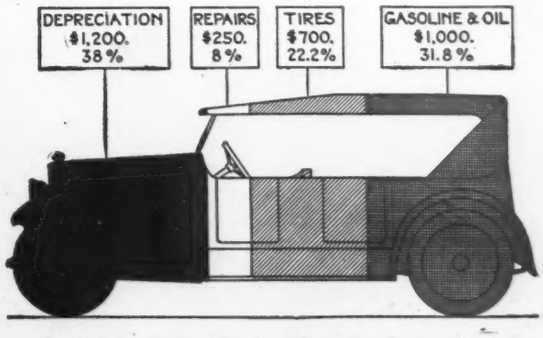
Looking back over all my experiences with two new and five used cars, I am forcibly led to conclude that any man is better off with a used machine at a given price than a new one at the same price—unless he can afford to buy the very best machine on the market. It makes little difference whether he has $500 or $5000 to invest. There are bargains in used cars at $5000 just as there are bargains at $500. It is true that $500 will buy a new machine that is well worth the money; but $500 will also buy one of several used machines priced originally from $800 to $1000, and only about a year old.

Also $500 will buy a two-year-old car originally listed at about $1500, and a three-year car catalogued at $2000. There is reason for pause here. These older, better machines have points of appeal that the glistening varnish on the new $500 car cannot gloss over in my mind's eye. The $2000 car is still a $2000 car. To be sure, it is a car with a certain definite percentage of its life already lived, but still a $2000 car.

Additional Advantages—Power and Good Looks

The lines are not quite modern, but they possess an air of refinement that the cheaper car must inevitably lack. But the car's performance interests me most. It runs without effort. It slides along at 50 miles an hour as though that were its customary gait. It devours the hills in a way that thrills me. On rough roads it possesses a stability that is both satisfying and reassuring. It is a thoroughbred and a bargain at the price.

One final point in the argument is the solution which the used car offers to the man who dearly wants a closed car, but who feels that his pocketbook limits him to the choice of an open model. Let him remember that while $800 will buy one of several new small open cars of reasonable merit, this sum will also purchase a used sedan or coupé only a year or so old.



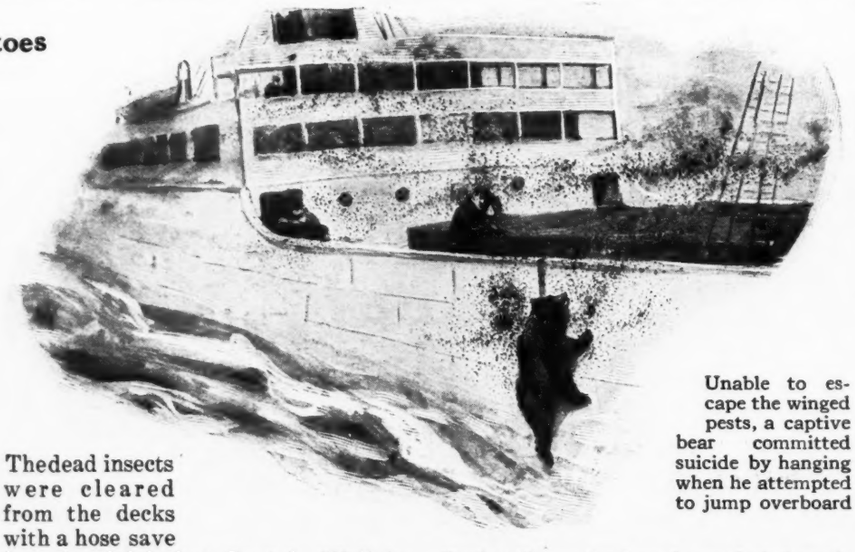
Percentage figures showing the cost of operating a used car costing $1800 for four years, with a total mileage of 40,000 miles. Although depreciation is greater than with the cheaper used car it is less than with a new $1800 car

Odd Items of Science from the News of the Month

Swarms of Migrating Mosquitoes Capture Ocean Liner

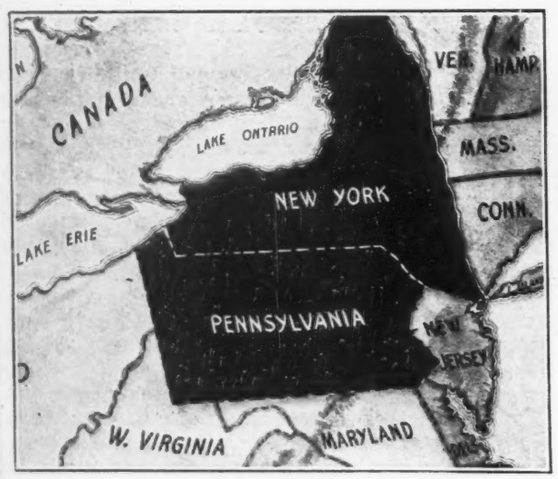
OVERWHELMED by vast clouds of vicious mosquitoes that drove blinded passengers and crew from the decks, the steamship *Spokane* is said to have had one of the oddest maritime adventures in history during a recent trip from Skagway to Seattle.

The wind-blown millions of insects descended upon the ship too suddenly to permit the closing of doors and portholes. The windows of the pilothouse were covered so thickly that it was impossible to see. All the crew and passengers were forced below decks, but even there they had to fight for breath in the midst of a whirling mass of stinging insects. A black bear, tied near the forecastle, was so maddened by the myriads of bites that it jumped overboard, and was hanged by its chain and collar. Within a few minutes the wind subsided, and the clouds of mosquitoes were seen to pass away to leeward. The dead insects were cleared from the decks with a hose save for a bottleful that Captain Wallaby brought into port to prove this oddest of sea yarns.



Unable to escape the winged pests, a captive bear committed suicide by hanging when he attempted to jump overboard

At the time of the attack the *Spokane* was a hundred and fifty miles from shore. The mosquitoes were undoubtedly sucked up from their breeding-grounds in the Alaska swamps by a small cyclone, and carried out to sea, since mosquitoes seldom fly more than a few hundred yards from their breeding place.



A spruce-tree reaches its maximum growth in forty-five years; an oak in seventy-five years. Yet fifty-seven million acres of these slow-growing trees, essential to life and industry, have been destroyed since 1916 by forest fires set by careless campers. This enormous area is equal to that of the states of New York and Pennsylvania. If this loss could be prevented, it is said that the increase in realty value would amount to nearly a billion dollars

If New York and Pennsylvania Were Burned Flat——

SUCH a calamity would be called the most disastrous conflagration in the history of the United States. Yet this is the area of American forests devastated by fires in the past four years.

The great war deprived Germany of 21,547,520 acres of land. During the same period a total of 56,488,307 acres were burned in the United States, a territory equal to New York and Pennsylvania combined.

More than 160,000 forest fires have occurred in the United States during the past five years, 80 per cent of which were due to human agencies and therefore preventable. The 2,000,000 feet of timber burned represents an economic loss of $85,700,000, and would have furnished material enough to build a five-room frame house every hundred feet on both sides of a road extending from New York City to Chicago. The population thus accommodated would be equivalent to a large city the size of Cincinnati, New Orleans, or Kansas City.

It is careless picnickers who cause the greater proportion of these fires.

Shifting Sand Covers Farms and Railroad

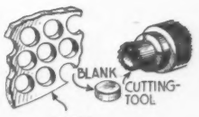
AFTER fighting night and day to keep their tracks free from wind-blown sand, two railroads running along the banks of the Columbia River, near Wallula, Washington, have given up the struggle and are soon to move their roadbeds to the top of the bluffs, out of reach of the sand. For months teams of horses and scrapers have struggled with the sand.

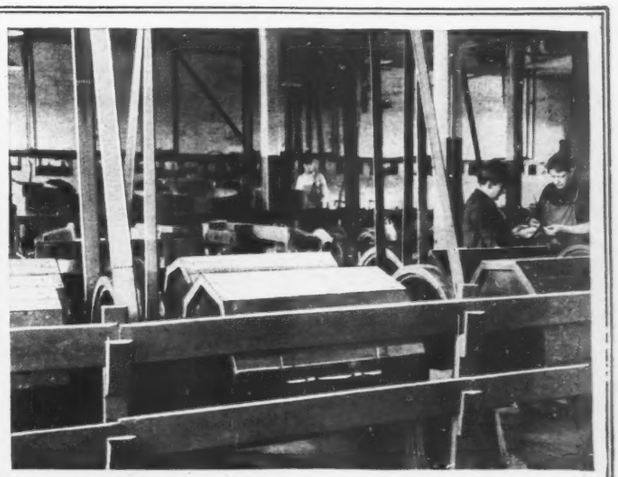
During the flood season the river deposits sand and silt on the Columbia's banks to a depth of from ten to fifteen feet, and as the water recedes, the wind picks up this fine, rounded material and carries it over the surrounding country. On the farm of H. R. Ostrom a pen and shed filled with four hundred sheep were buried overnight, and a few branches bearing apples protruding from the surface of the sand-dune is all Eric Johnson can show for a forty-acre orchard.

Railroads in the Northwest are relocating their tracks on the bluffs to escape the drifting sand

Science Aided by Machinery Makes Pearl Buttons From Mussel Shells

After being harvested, the shells are soaked in water to soften the flinty coating. The first operation is "blank-cutting," which is carried out by holding the shell in a glove-protected hand and pressing against the tempered-steel cutting-tool





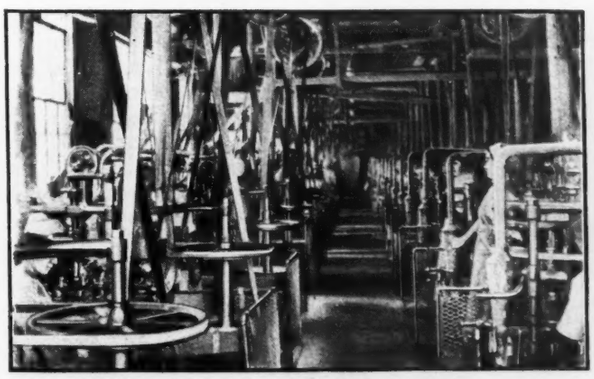
Then the blanks are sorted according to thickness. The hoppers discharge them on to two rollers set slightly out of parallel and sloping downward, with the widest opening at the bottom. As the blanks slide over the widening gap, they slip into the classifying tanks beneath

CLASSIFYING TUBES

TUMBLING-BARREL

Dirt and rough edges are removed by placing the blanks in wooden barrels and churning them slowly in a solution of pumice and water. When cheaper buttons are being made, common sand is sometimes used instead of pumice. It is coarser and quicker in its action

Through the combined action of steam and sulphuric acid the buttons are given their final high polish and luster in these rotating barrels. Then they are shaken in sawdust and washing powder to remove the acids and moisture



These machines change the blanks into buttons. Automatic machinery then carves out the desired pattern on the face and drilling machines drill the number of holes required. Over twenty distinct movements of the machinery are carried out in these operations

FORMING AND DRILLING PARTS OF AUTOMATIC MACHINE

CARDED BUTTONS

Formerly buttons were sewed to cards by hand. Now these automatic machines do the work. They attach each button in place by a separate wire so that during inspection or while in use, one button may be removed without loosening the others

How Caribou Meat Obtained by Airplane Would Increase World Food Supply

Three million head of "Arctic cattle" might be annual kill of aerial hunters

The Canadian Caribou Commission has figured that one million of these animals could be slaughtered annually without endangering the species, if only the bulls were slain

SOME twenty-five or thirty million caribou are roaming the plains beyond the sixtieth parallel of latitude in northern Canada, while a few degrees to the south, millions of people are demanding cheaper meat. What would be more logical than to bring together this seemingly inexhaustible supply and this equally insatiable demand? And what would be more unique than the plan to do it by means of the airplane?

It was originally suggested that airplanes be used to round up the caribou herds and then kill them with machine guns mounted on the planes

The caribou are there for the taking, but the big obstacle has been the matter of transporting the meat from the Arctic Circle where there are no railroads to the American dinner-table several thousand miles away.

It has now been proposed to hunt caribou by airplane and it is declared that the killing of from one to three million caribou bulls a year for meat would not endanger the future of the race.

The habits of the caribou make it comparatively easy to locate large herds from the air. While a few individuals remain throughout the winter on the islands along the Arctic coast, big herds, ranging from 100,000 to 500,000, begin to move southward in the fall and so great is their number that it often takes them several days to cross a stream. They have even been known to hold up steamers while they crossed the Yukon.

Some difficulties in the way of this airplane hunting are obvious. Driving a big herd with an airplane traveling at a hundred miles an hour would not be the easiest task imaginable, while to shoot down the animals by machine gun from the air would make it impossible to save the cows.

The Caribou Commission, created by the Canadian Government to study the problem and its possibilities, has decided, however, that the airplane can be of real service in placing caribou meat on the market. It is planned to use planes to locate the large herds and to assist in driving them to some strategic point where slaughter-houses could be established. With proper handling by airplanes, for instance, and with cooperation by cowboys on the ground, herds could be located and driven to Baker's Lake, whence the dressed meat would be transported to Port Nelson by motor-sled, where connections could be made with the northern terminal of the Hudson Bay Railroad.

My Three Years' Struggle to Perfect a Micrometer

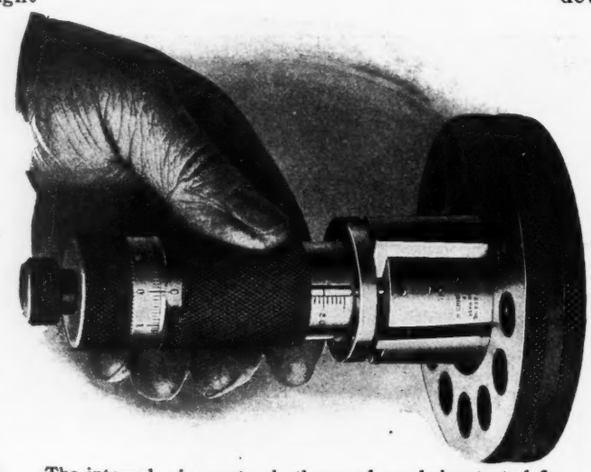
By John Bath

"Some find beauty in pure musical tones—others in the colorful touches of a masterpiece of art. To me, the correctly designed and perfectly executed mechanical achievement is beautiful."—JOHN BATH.

FOR the most part I believe that practical inventions rarely result from inspiration. I have been a mechanic all my life, and have always been troubled with the problem of measuring holes by micrometer, and the success that it brought me came as a result of long experience, hard work, and deep thought.

When working as a machinist I was often called upon to produce accurate mechanical fits. The machining of the shaft caused me no difficulty, for I could measure it and know with perfect confidence that the shaft was of correct size. But when I came to make the hole, I was always nervous. I never had confidence in my measurements. This feeling was the real reason for my determination to invent an accurate internal micrometer.

My first decision was that a line contact for measuring the hole was essential. To this end I constructed numerous designs. Finally I settled on a micrometer of four jaws controlled by a micrometer screw. A period of over three years of concentrated thought and development has been required for the perfection of the invention.



The internal micrometer is shown above being tested for accuracy with the reference standard that always accompanies it

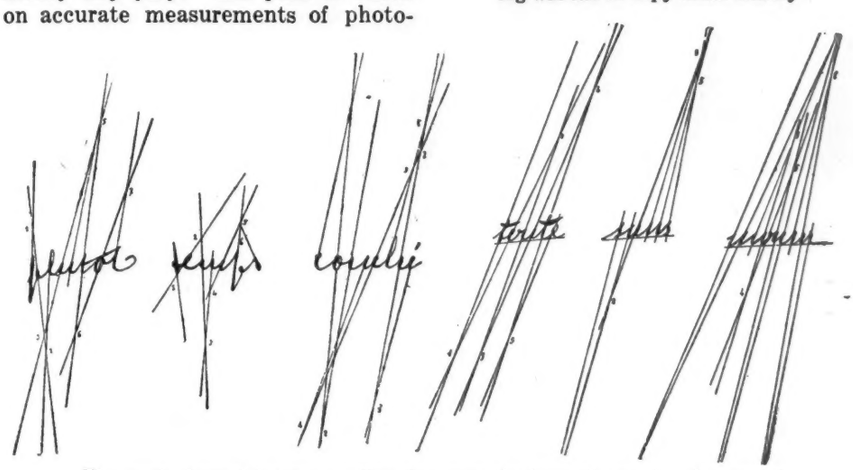
The idea of the master ring that is used for setting the micrometer to size is distinctly new and a departure from standard practice, but my first conception of it has remained unchanged. The idea of a deep wall ring lightened with a series of holes, was, one might say, an inspiration. Nevertheless, I would never have had this inspiration if my years of experience—just like any other mechanic's—had not permitted a painstaking study of the requirements to be fulfilled by the perfected device.

Enlargements of Handwriting Sure Way to Expose Forgeries

French police perfect method to detect work of clever "freehand" forgers

OF all methods of forgery those of the "freehand" experts have been the most difficult to detect. But a system lately developed by Doctor Locard, Director of the Laboratory of Police Technique at Lyons, France, reveals the work of "freehand" artists conclusively enough to satisfy any jury. His plan is based on accurate measurements of photographic enlargements of the suspected penmanship.

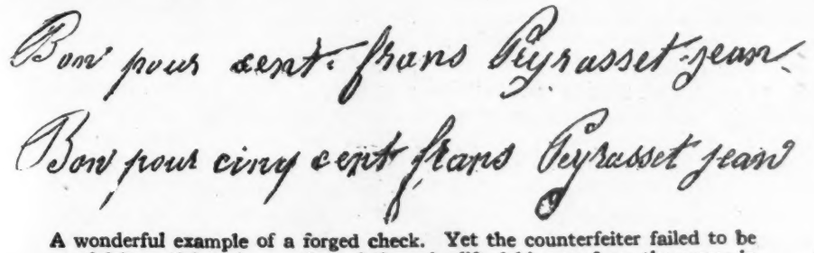
"Spears" on the tails of written letters are always an indication of their genuineness. Even an expert in handwriting will fail to copy them exactly



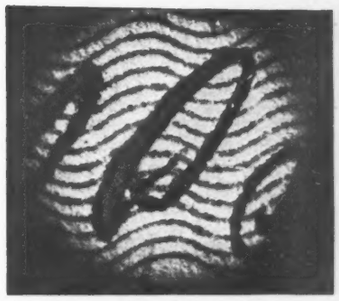
The angle formed between a line drawn at the base of a word and a second line through the center of each letter never varies. This fact condemns the example above on the left, much as it looks like the original hand

Even a signature is never written twice in precisely the same way, but each individual handwriting has certain constants that may be readily determined and measured and that are not altered even when a man attempts to disguise his own handwriting. For example, the relation that exists between the average heights of the letters never changes. If a man increases the general size of his hand, he will increase the height of all the letters in the same proportion. If he is in the habit of making an S very large and an i very small, this relation will persist. If he habitually writes the last letters of a word smaller or larger than the first, this order will never be modified.

Laboratory of Director Locard of the Laboratory of Police Technique, where the science of forgery detection is practised. In the center is the enlarging camera used in this work



A wonderful example of a forged check. Yet the counterfeiter failed to be careful in noticing the number of times he lifted his pen from the paper in making the words. No two persons agree on this detail



This "o" was formed from right to left and the peculiarity cost the writer his freedom and 95,000 francs. But for the photomicrograph the forger would never have been caught

When the angle formed by the axis of each letter with the base line is measured, it is found that although this varies for the different letters, nevertheless the mathematical relation between the angles remains the same.

M. Locard has also discovered that it is exceedingly rare for words to be written from beginning to end without raising the pen from the paper. Careful study of the frequency of these interruptions forms another check on the authenticity of a handwriting specimen.

When a suspected document is submitted to a handwriting expert for examination, he first makes an enlarged photographic reproduction and scrutinizes this for marks of alteration or erasure. Sometimes it is possible to demonstrate that it is a tracing, which is proved by the perfect similarity of the writing with words written by the person whose hand is being forged.

If these methods prove nothing, the document is either genuine or a freehand forgery, and the measurements outlined are undertaken. In exceedingly accurate forgeries, the results obtained are verified by study of greatly enlarged photographs, which show whether the writer forms certain letters from left to right or vice versa.

One forger imitated almost every feature of his copy, except the fact that in the original hand the small o was always formed by a movement of the pen from right to left. The error would never have been discovered if the police had not examined the forgery under a powerful microscope.

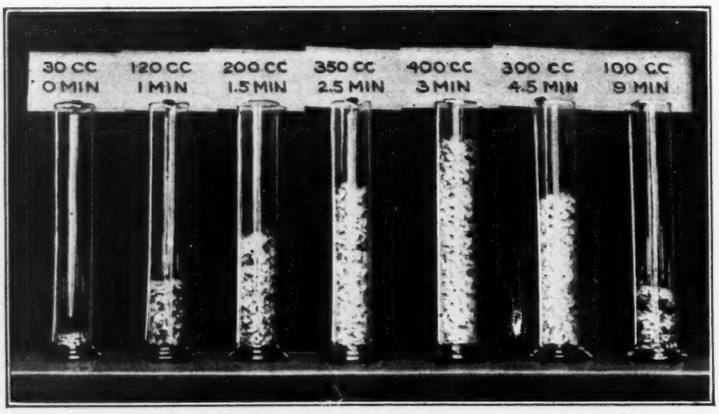
The microscope is also used to detect the presence of what is termed "spears," or the individual little curves that are made in the portion of letters like p, g, and y, extending below the line. A mistake in this detail led to the arrest of a man who had forged a check for 95,000 francs.

What Puts the "Pop" in Pop-Corn?

Science explores the inside structure of the kernel

Published by courtesy of the American Chemical Society

DO you marvel at the action of pop-corn? Have you often wondered what causes the "pop"? In the many years that pop-corn has been used as a food and a confection this question has never been answered until a short time ago when science set out to study pop-corn and its inside structure. Dr. R. H. Carr, of Purdue University, was in charge of the experiments.



Corn will pop best when heated for three minutes before the popping starts, according to the results of this test. Too rapid or too slow heating destroys the popping qualities of the corn

In the beginning he believed that popping might be due to the amount of water contained in the corn. He tried heating corn with varying water content and found that this theory was wrong. Next he studied the proteids, thinking that grains containing the highest protein content would pop best; but again he found that he was wrong. His third experiment, and the one that solved the problem, concerned the rate of heating the corn.

Dr. Carr took thirty cubic centimeters of corn and heated it rapidly. The popping commenced in one minute and continued until he had obtained one hundred and twenty cubic centimeters of popped corn. Then he tried the same amount and heated it less rapidly. This time he got a yield of two hundred cubic centimeters. He kept on in this way, gradually reducing the rate of heating. With the final results of the various tests before him, he studied the contents of the test-tubes shown in the illustration.

It was a simple matter to see that the largest volume of popped corn was produced when the grains were heated slowly for three minutes before they commenced to pop. Shorter and longer heating periods reduced the production proportionally.

To complete the tests both chemical and photomicrograph examinations were made to ascertain the reason for this action. It was decided as a result of these tests that when the corn is heated too rapidly the starch in the cells does not have time to become gummy—or as the scientists call it, dextrinized—before the popping takes place. Therefore the starch should be allowed three minutes of gradual heating.

The chemical change of the starch to dextrin is accompanied by a considerable dilation of the cells of the corn. These cells are filled with steam, produced not by the water in the kernel but by hydrolis—the forming of water from the constituents of the corn. As the steam increases, there comes a time when the pressure is too great, and the "pop" then takes place.

The Oldest Ship that Sails the Sea

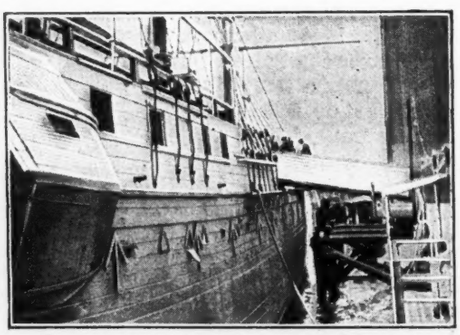
A CURIOUS assemblage of ghosts might walk the decks of the little three-masted vessel, *Success*, at present making a tour of the world. She was launched in 1790, at Moulmein, British India. Princes, nabobs of the Orient, and rich merchants of India, miserable convicts doomed to years of torture, and finally the royal personages who have visited the hulk in recent years, would constitute the phantom crowd.

To-day the *Success* is a museum upon whose decks are exhibited the instruments of torture employed while the ship was used as a convict transport and prison. Until 1802 it carried rich cargoes of spices, aromatic teas, ivory, and valuable products of the East. Then it was converted by the British Government into a convict ship, on which sentenced prisoners—many convicted for the most trivial offenses—were conveyed to Botany Bay, the convict settlement in Australia.

An old iron chest on the *Success*. It is made of strips of beaten iron

The vessel has a tonnage of eleven hundred, and is 135 feet long with a thirty-foot beam. The solid sides of Burmese teak are more than two and one half feet thick at the bilge. The between decks and the lower deck are fitted with dark, narrow cells, and there are two "black holes" in which the prisoner could neither sit down, stand upright, nor recline. The slanting side is worn smooth where the desperate victim tried to get a foothold as the ship rolled in the sea.

Over fifteen million visitors have inspected the vessel, and many notable persons, the late King Edward, of England among them. It is now used as a floating museum, circling the world under its own canvas, in the interests of prison reform. The arrows on the side of the hulk indicate to all and sundry that it is a convict ship, the broad arrowhead being an insignia that was also branded on the palm of the convicts' hands and that is still used on the prison clothes of English convicts.



The convict ship *Success*. The arrowheads mark it as a prison ship

How Hot Is the Ash of Your Favorite Cigar?

This test of its temperature reveals its quality

OF all the qualities that are essential in a good cigar, none is as important as the "burn." This term includes many points, the most important being evenness of burn, color, firmness, and coherence of ash, and fire-holding capacity.

Chlorides in the tobacco tend to prevent complete combustion and the forming of products injurious to the flavor and aroma. On the other hand, the carbonates of the alkalies, particularly of potassium, aid the combustion and increase the fire-holding capacity.

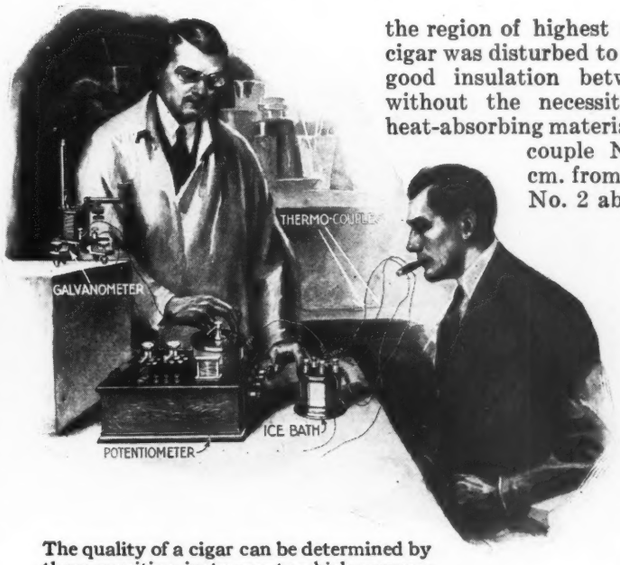
In order to study carefully the action of the various salts upon the course of combustion of the cigar, a knowledge of the temperature of the burning cigar is necessary.

The United States Bureau of Plant Industry has developed a method of determining the maximum temperature within the burning cigar.

Thermocouples were composed of the following wire: Platinum 0.01 cm. and 0.015 cm. in diameter, and platinum alloyed with 10 per cent. rhodium of the same diameters. The potentiometric method of measurement was used.

In order to eliminate conduction and leakage, only couples composed of very small wires were used, so the platinum-rhodium couple was chosen.

A small glass capillary tube drawn down to a point was thrust through the cigar at a point about 2.5 cm. from the tip of the cigar. One of the wires of the couple was then passed into this tube and so through the cigar, the tube withdrawn from the cigar and removed from the wire, and this wire joined to the other wire of the couple by arc welding. The point of junction was then pulled back to the center of the cigar and the small holes around the wire plugged with paper pulp. In this way the junction was located in the region of highest temperature, the filler of the cigar was disturbed to only a very small extent and good insulation between the wires was secured without the necessity of introducing additional heat-absorbing material into the cigar. The smaller couple No. 1 was located about 2.5 cm. from the tip with the larger couple No. 2 about 2 cm. farther back.



The quality of a cigar can be determined by these sensitive instruments which measure the temperature of the burning tobacco

TABLE I

	Couple No. 1 Degrees C.	Couple No. 2 Degrees C.		Couple No. 1 Degrees C.	Couple No. 2 Degrees C.
Cigar I	835	839	Cigar M	807	825
Cigar J	865	842	Cigar N	837	802
Cigar K	886	887	Cigar O	892	910
Cigar L	925	813			

TABLE II

Cigar I		658	Cigar L	670	657
Cigar J	717	668	Cigar M	803	708
Cigar K	584	629			

Table I shows maximum temperature records for seven makes of cigars; Table II gives maximum stationary temperatures in the ash between puffs

The apparatus was adjusted and the cigar lighted. As soon as a temperature near 300° C. was indicated, readings were taken of the highest temperature reached during the puff, and of the temperature in the coal of the cigar about thirty seconds after the puff. These latter readings were taken to determine whether the point of highest temperature had been reached as indicated by a rising or falling temperature.

The time interval between puffs was one and one half minutes and the duration of the puff was from five to eight seconds. An attempt was made to keep the draft and, consequently, the rate of combustion, normal. When the temperature indications began to decrease on successive puffs, the other junction was switched into the circuit and a similar set of readings taken. The couples, as taken from the ash, were usually check-standardized with boiling sulphur as a reference point.

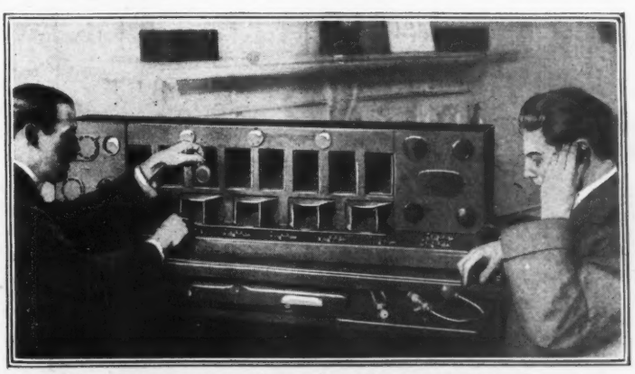
The platinum-rhodium couples were selected of different sizes of wire in order that any great lowering of temperature due to conduction along the wires might show up a consistently low reading of the larger couple.

Thirty-five Hundred Varieties of Human Hearing

LACK of good hearing is often due to lack of ear education. Many people who do not hear easily may educate their ears.

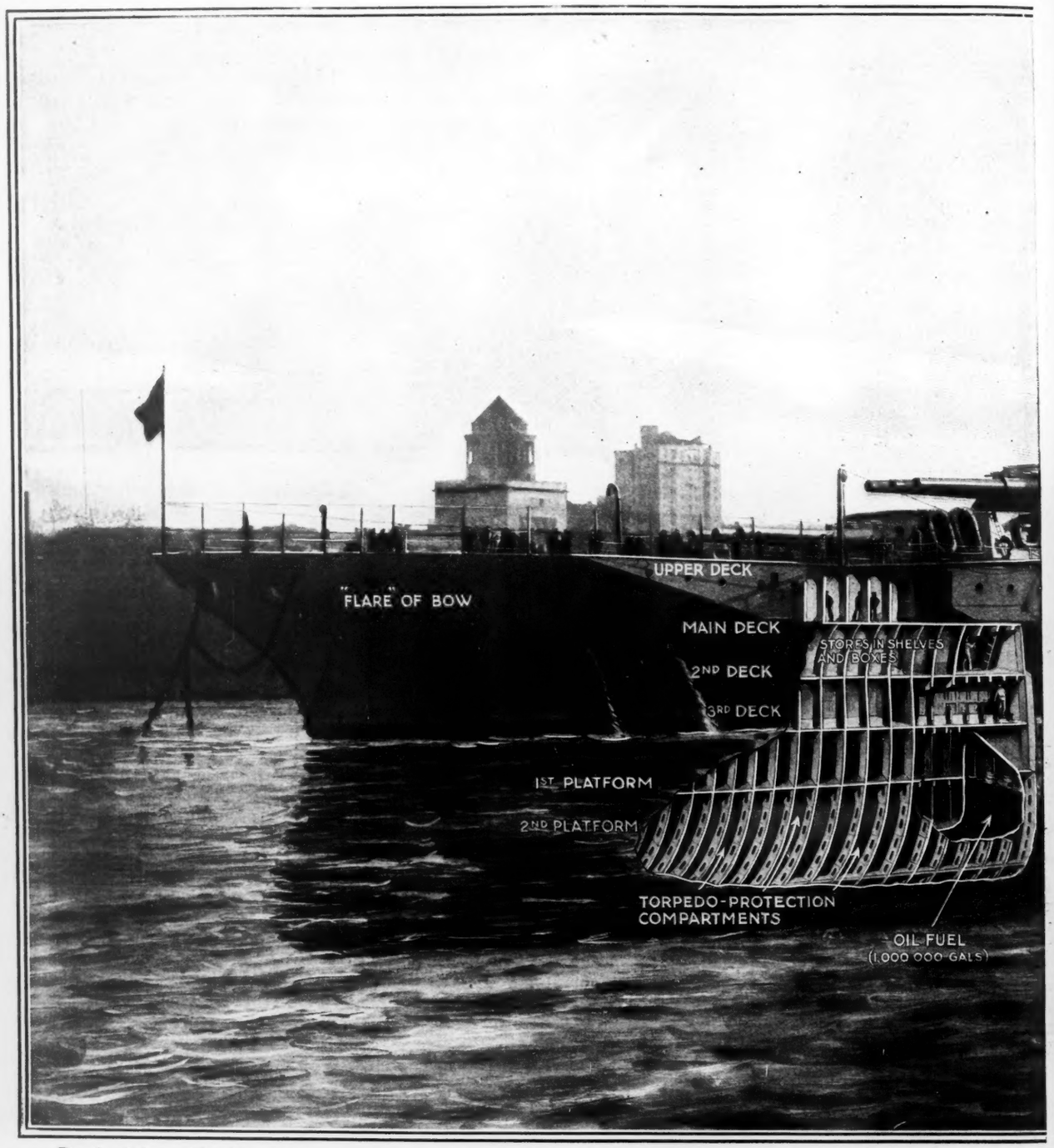
With the use of the apparatus here shown, it has been found that human hearing is divided into thirty-five hundred classes. The normal ear can hear the sound produced when fingers are stroked across a piece of paper. Ears that cannot hear it may have their degree of hearing determined by the apparatus illustrated. Later a receiver is designed that will aid that particular condition. It is possible to correct all defective hearing, with the exception of congenital deafness.

The sound educator acts directly on the basilar membrane, which is that part of the ear where the sound accommodation is effected. It increases the vibration to a point where maximum hearing is brought about for all types of ears.

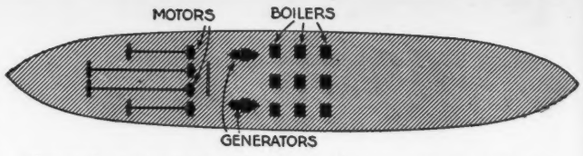


After this apparatus determines the exact status of your hearing, a receiver is designed to aid any particular fault

Inside Workings of the Battleship "New Mexico"



Popular Science Monthly publishes above the first picture to be made public showing the interior construction of America's greatest fighting unit—the all-electric *New Mexico*



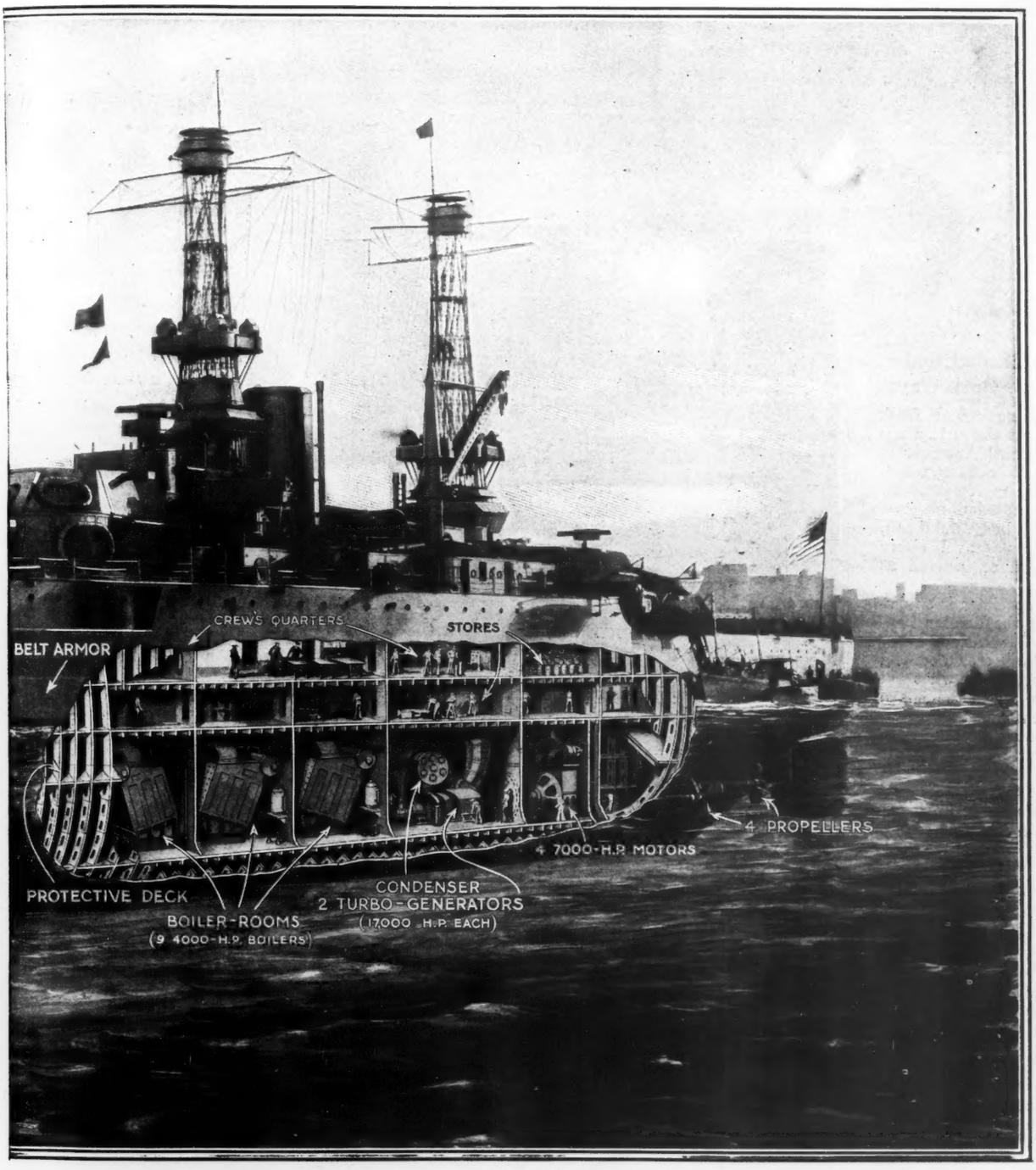
General arrangement of boilers, turbo-generators, control switchboard, and propelling motors on the electrically driven *New Mexico*

WITH the formal acceptance of the *New Mexico*, the United States navy has the honor of possessing the first electrically propelled battleship in the world. Added to this distinction and making it one of the most formidable fighting units in service, are its heavier guns, wider cruising radius, and greater maneuvering ability.

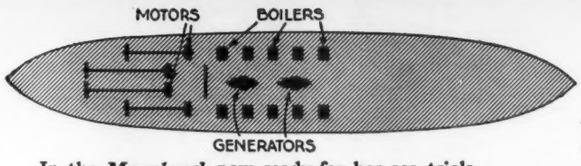
The propelling machinery of the *New Mexico* consists of two steam turbines of 17,000 horsepower, driving generators to supply power to four 7000 horsepower motors. The motors are connected direct to the propellers and turn them at the rate of 170 revolutions a minute, equivalent to a speed of twenty-one knots. Three other turbo-generators of small capacity furnish the necessary current for the multitude of electrically driven machines and accessories.

Steam for the turbines is produced by nine oil-burning boilers. The small

The World's First Electrically Driven Fighting Ship



Photograph of the *New Mexico* with one side partially cut away to show the relative positions of the new electric drive, the crew's quarters, and the fuel space



In the *Maryland*, now ready for her sea trials, the steam turbines are in the center, with the boilers along the side

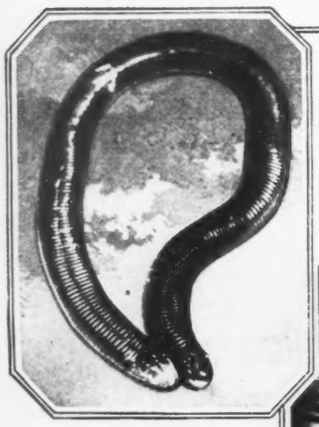
drawings show the relative position of the boilers and propulsion machinery in this ship and in the later vessels of the same class. Bunker space is provided for a million gallons of fuel oil, which is sufficient to give the ship a cruising radius of 10,000 miles.

The *New Mexico* is an electrical ship in every meaning of the word. In addition to being the direct propelling force of the battleship, electricity is used to operate loud-speaking telephones, gyroscopic compass, steering-gear, anchor windlass and all the winches, air compressors, ammunition hoists, range signaling apparatus, and the movement of guns. Electric heat is used in the kitchen and in the laundry and all the mechanical departments are motor operated.

The *New Mexico* is the first of six battleships of its class. The *Maryland* is the next to be placed in commission. After her will come the *California*, *West Virginia*, *Colorado*, and *Washington*.

Picture News of Science Oddities from All Over the World

© Kadel & Herbert



Two-Headed Snake Travels Both Ways

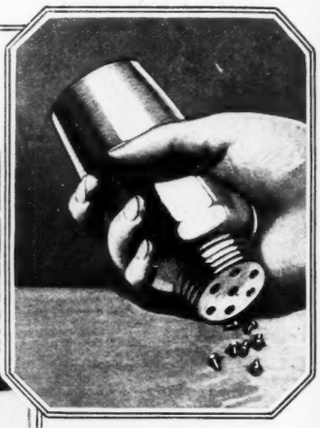
THE zoological freak shown above is a native of South America. It is a snake without a tail. Not only has it a perfectly developed head at each end of its body, but it can, and does, travel either backward or forward at choice.

The specimen is on display at the London Zoological Gardens and every day a large crowd collects and waits to see what will happen when the snake sees something good to eat in both directions at once and starts a tug of war with itself. So far, this has not taken place, but any one who has trouble making up one mind should pity this animal.

IN 1920, 1,234,222,889 persons traveled by railroad, and 4,932,000,000 by automobile.

Automobile Takes the Sky Line

STRAIGHT and narrow was the path followed by Harry Piel when he drove his car across two metal bars that connected the roofs of two seven-story buildings. Had he wavered, he and the car would have crashed to the street.



Keep Small Screws in a Salt-Shaker

USE a salt-shaker for small screws and tacks. Above, you see an old glass salt-shaker that is partly loaded with small screws. When the owner wants a few screws, he shakes the shaker and out they roll. This is much easier than the usual process of hunting through a box of assorted screws.

S. A. Rhodes, of Chicago, is responsible for the idea. He builds optical instruments and small clocks, in the assembling of which tiny screws are necessary.

AMERICANS eat twelve times as much salt as they need, but the excess does little harm. Scurvy, which was the plague of sailing-ships on long voyages when the diet consisted of salt meat exclusively, is caused by the absence of vitamines and not by the excess of salt.

Cheetahs Are Trained to Hunt in India

IN India and Ceylon the cheetah is used for hunting, just as some breeds of dogs are used for the same purpose in the United States and elsewhere. In fact, while the cheetah resembles the leopard in many respects, he really belongs to the dog family.

The natives train him to chase an animal and hold it at bay until the hunters arrive. The picture below shows a cheetah traveling to the hunting-grounds in an ox-cart.

Natives of India taking the cheetah to the forest to hunt game

Lobsters Caught Fresh from the Sea

PICTURED below is a boatload of lobsters, fresh caught and lively. There are over a thousand in the heap, and if the next lobster-pot is as full as the last, there will be no room aboard for the crew.

Notice the heavy gloves worn to protect the hands in lifting the lobsters out of the pots in which they are caught. This boatload is an unusually heavy catch even for the Maine coast in the height of the season.

Courtesy U. S. Bureau of Fisheries

A boatload of lobsters on their way to the fishmonger

Lamp Lights as a Signal to the Waiter

NOTHING more nor less than a life-saver is this little lighthouse. Every one knows that after the dinner is over, the waiter vanishes, and one waits in vain for the check.

With this lamp you can signal him by pushing a button. There is no need to whistle as loudly as you dare, or accidentally drop a fork, or glare about, until one of the waiters finally notices that something is wrong, and comes to see what it is.

Pushing a button lights an electric lamp in the top of the lighthouse, and when the waiter sees it burning, he knows you want him.

IF fish are frozen quickly, as by immersion in brine tanks at 10° F., the flavor and physical characteristics of their flesh are unchanged. After thawing they cannot be distinguished from fresh fish. This method of rapid freezing is being used to improve the flavor and quality of cold-storage food.

Europe Going in for Skyscrapers

BERLIN is the city that will give Europe her first real skyscraper. It is to be twenty-two stories high, and, as the illustration shows, will be an impressive building, of typical American construction.

Although this skyscraper's chief reason for existence is to house a railway station, the building will be used also for offices, a moving-picture palace, and restaurants.

Note the suggestion of ornamentation that softens the architecture of a strictly utilitarian building. New York City has several striking examples of such a combination.

Europe's first skyscraper will house a railroad station, a movie, and cafés

She Is Testing the Perfume of Flowers

IN botany classes where the student is trying to distinguish the perfume of one flower or plant from another it is advisable to eliminate all other odors. It requires intense concentration to do this without the help of the simple device shown in the illustration.

The nosepiece fits tightly to the face and is connected with the mouthpiece into which the flowers to be tested are inserted. Then, only those perfumes are conveyed to the nose that originate in the plant being studied. The device is used in English botany schools to estimate the varying amounts of fragrance emitted by varieties of the same kind of bloom grown under different conditions.

Do you know that, in proportion to its size, Ceylon produces a greater quantity of graphite and of purer quality than any other part of the world?

Dwarf Automobile Moves Punch and Judy Show

ONE of the favorite amusements of English children is the Punch and Judy show. A Londoner is the father of the modern Punch and Judy on wheels. He has set up his theater on the hood of a tiny five-horsepower automobile, and tours the country districts of England, giving a performance by the roadside wherever a crowd collects.

The sight of this novel vehicle moving slowly through the streets never fails to gather a large audience of children.

Punch and Judy on wheels is a new idea for the theatrical world

Was This the Start of the Trailer Idea?

THE village bus-driver of Sodus, New York, developed the first trailer to be used in this country, according to the claim of his fellow citizens. He started the idea over twenty years ago and used it successfully to carry baggage. The trailer shown in the picture was used by its originator's successor.

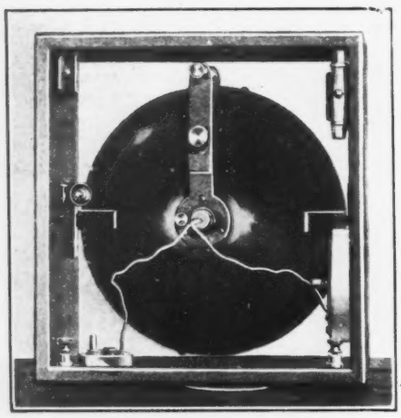
At the time the trailer was built there was not a firm in the country making them. All work on it was done in the village blacksmith shop.

The first trailer used in this country was for carrying trunks

74,000 Candlepower Searchlight for Night Surveying

A MODIFICATION of the surveying searchlight has been designed by E. G. Fischer of the United States Coast and Geodetic Survey. This instrument is used to mark the triangulation points in surveying triangles the sides of which are from ten to one hundred miles in length. It is also used by surveyors at night or when hampered by fog or smoke.

The newest model is light and portable, economical in current consumption, and with highly concentrating reflecting power.

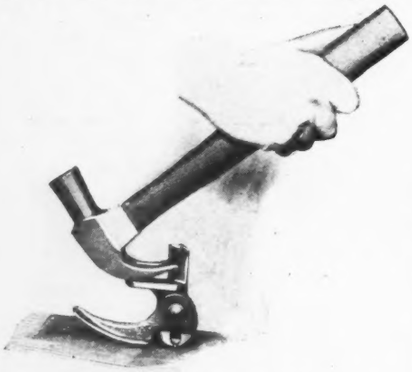


Geodetic surveyors are using this powerful searchlight for night work and in foggy and smoky atmospheres

The source of light is a comparatively small incandescent bulb rated at 3.7 volts, 0.6 amperes, but the filament is highly concentrated. Since the light originates from what is, for practical purposes, almost a mathematical point, the reflection secured is nearly perfect, which makes the searchlight extremely powerful for its size and weight. Bureau of Standards tests give the apparent beam candlepower at 100 feet as 74,000 on a current consumption of 66 amperes at 5.4 volts.

Pocket Extractor Pulls Buried Nails with Ease

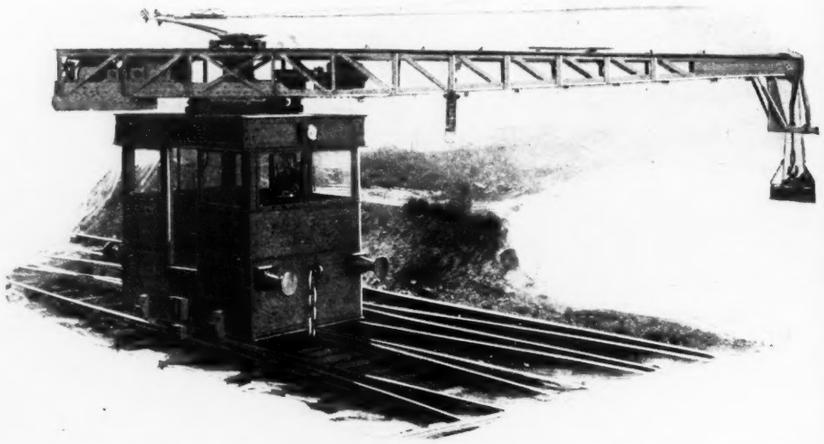
NO matter how far the head of a nail may have been driven below the surface of the board, this pocket-size nail-puller



The hammer drives the claws over the nail head and then furnishes the leverage to withdraw the nail

gets it out without fuss or delay. Set its claws over the nail, and tap the top of the puller with a hammer until the claws take hold. Then use the hammer as shown.

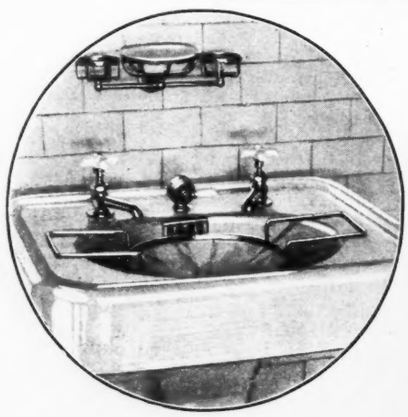
Magnetic Crane Shunts and Unloads Cars



ONE of the problems the plant superintendent had to solve was how to unload cars of sheet bars and steel plates at scattered points in a large plant. The magnetic crane was the most efficient method. But to-day a car must be unloaded at one end of the plant, and to-morrow at another, a mile or more away. Loading costs are reduced by the use of a combination locomotive and crane pictured above.

No switching engine is necessary. The locomotive shunts the cars and unloads them rapidly at the point where the material is desired. The engine is far more powerful than its size would indicate. It will exert a drawbar pull of 2600 pounds for an hour, 4200 pounds for thirty minutes, and 5400 pounds for fifteen minutes, within limits specified for traction motors. Its maximum speed is between six and seven miles an hour.

To enable the engine to unload material from cars behind it or on adjacent tracks and to pile it on either side of the rails, the crane has a radius of twenty-eight feet, and is capable of lifting 3000 pounds at forty feet a minute, and of slewing in a complete circle with this load in thirty seconds. The lifting magnet is tested apart from the crane, and is capable of lifting five tons. To give the engine sufficient weight to keep it on the track when the maximum load is lifted, the framework is entirely constructed of steel one inch thick, and is strongly braced with heavy angle-bars.



Portable Wash-Basin Folds into Smal Space

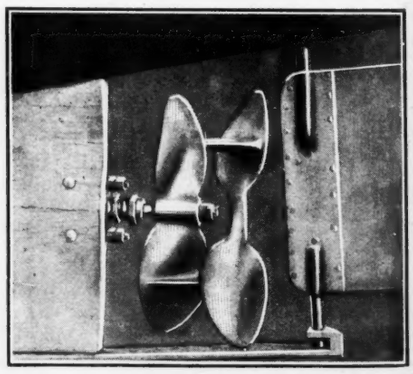
RATHER than take a chance with the cleanliness of the hotel lavatories encountered in his travels about the country, a resident of New Jersey has invented a portable lavatory that can be folded up into a space no larger than a magazine.

The lavatory consists of a piece of waterproof material stretched loosely between an oval frame so as to form a shallow basin. The frame is held by supports that are made to rest on the sides of the common lavatory bowl. The improvised basin hangs free from all surroundings and the user may splash to his heart's content, knowing that there is no danger whatsoever from contamination.

A new piece of cloth costs but a few cents.

Twin Propeller Permits Larger Engines in Small Ships

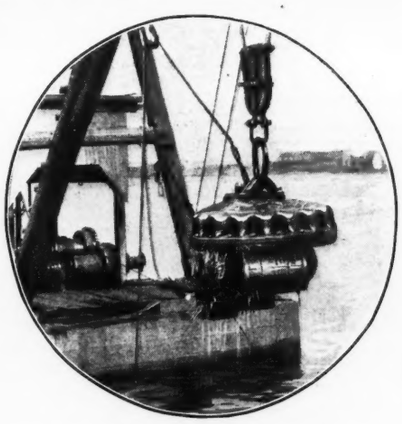
THE inventor of the double propeller, P. J. Griffin, of Boston, Massachusetts, claims he has made a distinct improvement in design, since its diameter is only two thirds that of an ordinary propeller of equal propulsive force. It will permit the use of



Twin propellers having specially designed blades make it possible to equip boats with bigger power plants

a more powerful engine on small boats without danger of "belling," and may be used on any form of marine craft.

The feature of the design is the skilfully calculated curvature of the blades, which are so designed that the rear blade is not subjected to the back wash from the forward screw.



Magnet Salvages Nails from Ocean Bottom

PICTURE, if you can, the endless task of picking up a million nails from the bottom of the ocean. There is no way in which it could be done other than the method used—by electromagnet. Some of the casks containing the nails in the sunken cargo were broken wide open and their contents spread over the mud under many feet of water, but the magnet got them all.

The derrick lowered a powerful magnet over the spot where the ship sank, then dragged it around slowly over a wide area. At intervals the magnet was raised to the top and the accumulation of whole barrels, broken barrels, and loose nails dropped off into a container, by simply removing the current which had produced the magnetic force. It is probable that many of the loose nails were drawn up through a considerable depth of mud and silt.

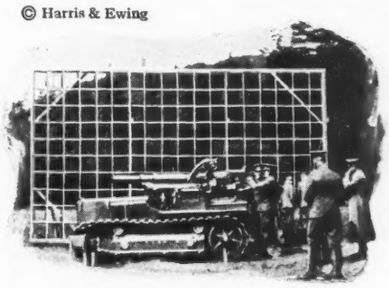
New Caterpillar Tractor Travels Thirty Miles an Hour

OF course, we have known that a caterpillar tractor can go anywhere, but we never expected it to go there very fast. We thought a man driving a tractor ran about as much risk of arrest for speeding as his brother in a steam-roller. But this tractor will do thirty-one miles an hour, in spite of the weight of the gun and its load of passengers.

The speed is made possible by the use of rubber treads on the tracks and rubber facings for the truck wheels and the two large sprockets in each track. The rubber absorbs the shocks at high speed, and the machine runs smoothly and very quietly.

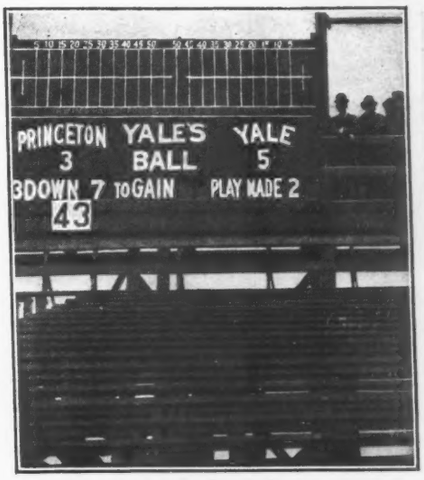
The mount has recently been waterproofed, and has proven itself able to cross

© Harris & Ewing



A new army caterpillar tractor can travel thirty miles an hour and ford streams of considerable depth

streams where the depth was sufficient to submerge it entirely except for a tube containing the breather and air intake. This makes the tractor comparatively independent of bridges.



Scoreboard Describes Football Plays to Spectators

FOOTBALL, the game of many rules and many happenings, is no longer the puzzle to the inexpert spectator that it once was. This cover-all scoreboard now comes to his aid in practically all of the large college stadia of the country, reporting the game play by play.

The score, the possessor of the ball at the moment, the line from which the ball is to be played, the number of the "down," the yards to gain, who "downed" whom and the minutes to play, all appear in big white figures on the board, while a miniature football follows the play on the big gridiron by moving up and down and across the "yardlines" on the little replica so as to show every spectator the exact point at which the pigskin is in play.

To operate this board at game-speed two men follow the ball up and down the field, wigwagging every play with arms, head, and feet to some twenty men who stand behind the board decoding signals and moving markers at top speed.

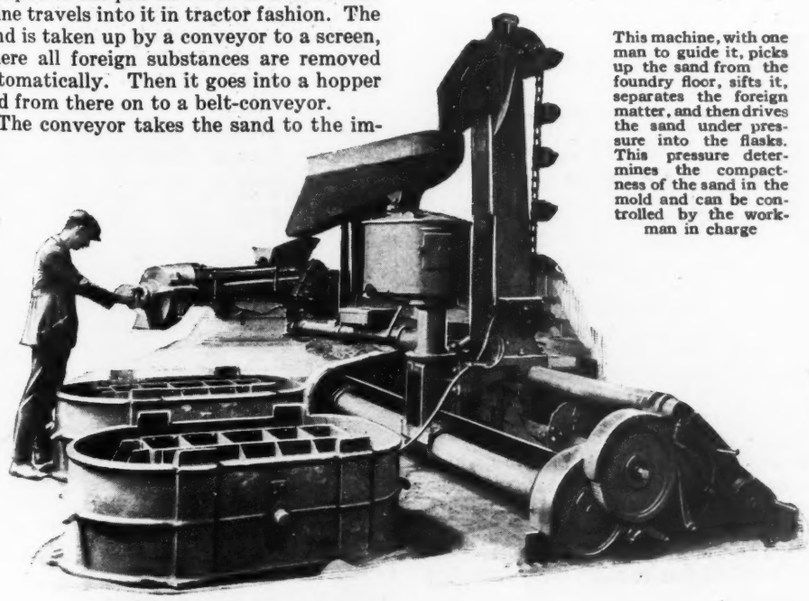
Sand-Slinger Does Work of Eight Men

IN large foundries a considerable force of men is needed to ram the sand into the flasks. But before being rammed, the sand must be riddled and all the pieces of scrap taken out.

An electrically drawn sand-slinger does all this work and does it eight times faster than a man could do it. The sand is dumped in one pile on the floor and the machine travels into it in tractor fashion. The sand is taken up by a conveyor to a screen, where all foreign substances are removed automatically. Then it goes into a hopper and from there on to a belt-conveyor.

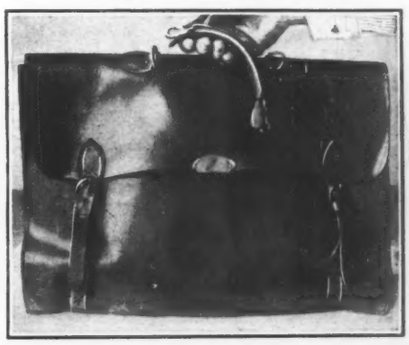
The conveyor takes the sand to the impelling head, which drives it with great force into the mold. One man controls the operation of the entire machine and varies the density of the ramming according to the demands of the job.

One man can ram about one cubic foot a minute, but this machine completes ten cubic feet in the same time.



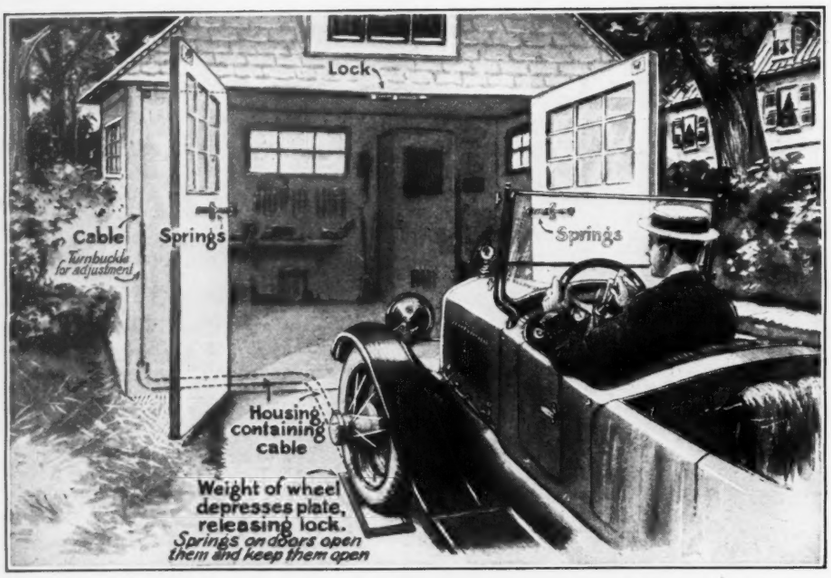
This machine, with one man to guide it, picks up the sand from the foundry floor, sifts it, separates the foreign matter, and then drives the sand under pressure into the flasks. This pressure determines the compactness of the sand in the mold and can be controlled by the workman in charge

The Brief-Case Acquires an Extra Handle



THE handle of a brief-case is the part that wears out first. A manufacturer recognized this fact and has brought out a special handle that makes replacements easy. A simple harmless hook on each end of the grip with a sheath to protect the hands from the metal comprises the new product.

"ALCO bronze," an alloy of aluminum and bronze, is said to be stronger than any other bronze. It has the color and luster of gold.



Wheels Open Garage Doors Automatically without the Driver Leaving the Car

BY setting an iron plate in the driveway leading to his garage door, and connecting it with the latch, an ingenious automobile owner opens the door without leaving his seat.

Nothing could be simpler than the method of operation. The doors are held shut normally by a spring lock, but there is always a tendency for them to swing open, caused by powerful springs on each side. From the spring lock a wire cable leads outside and underground to the steel plate set in the approach. When one of the wheels is driven over this plate, the latter is depressed and the cable is operated. This unlatches the spring lock and the door springs complete the work by swinging wide the doors and holding them in that position.

To reset the device it is necessary only to push the doors shut and see that the spring lock catches.

Pavement-Breaker for Starting Pipe-Trenches

ENGINEERS of the Board of Water Commissioners in Detroit have designed a machine for breaking pavements that will cut trenches for water-pipes

This machine works like a pile-driver and can break through fifteen inches of concrete pavement a minute

through a ten-inch concrete pavement base with a great saving in labor cost.

The machine is practically a small pile-driver mounted on two short crawler tractors. While the hammer is on the up stroke, it is moved across the cut. The extreme width of trench possible without moving the machine is six feet. The hammer has a hoisting speed of seventy-six feet a minute, and can be shifted twenty inches between the blows, which are struck every four seconds. It is raised by three tilting spurs on the hoisting-chains that engage lifting lugs on the hammer.

The road speed moving from job to job is about a mile an hour. At work fifteen inches of pavement are broken up a minute. One operator and a laborer run the machine, which uses a fifteen horsepower gasoline engine.

Drydocking Big Ships by Telephone

AN ocean liner must be held precisely over the center line of the dry dock until the supporting blocks are put in place under the keel. Guiding the ship into position is the duty of the dockmaster, who stands at one end with a sighting vane which he alines on the ship's masts. With large ships and modern docks, however, he is too far away from the men who carry out his orders to reach them by shouting, even through a megaphone.

A portable telephone is used by which the dockmaster communicates with the power house operating the dock pumps, and from that point his instructions are relayed to the proper gangs, who may be eight hundred feet or more away from the dockmaster.

Wellesley Has Formaldehyde Closet for Sneezers

SNEEZING is a warning of a cold. At Wellesley College there is a little white, zinc-lined room that is guaranteed to make one sneezeless and snuffleless provided one seeks it in time.

When the twitching nose is first felt, a trip to the "coryza closet" is immediately

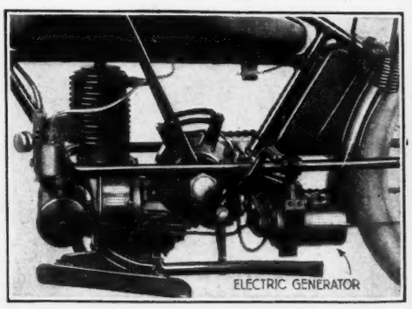
College girls go to this first aid closet when a sneeze foretells an incipient cold

made. Here the fumes of formaldehyde and eucalyptus oil are inhaled. The tight-fitting door prevents the escape of the fumes and if the patient remains in the place for a few seconds, there need be no fear of the cold getting beyond the first stages.

An Electric Generator for the Motorcycle

A MAKER of motorcycles has appeared on the market with an electric machine that includes in its equipment magneto ignition and a generator furnishing current for headlight and taillight.

The generator is swung low between the gear-box and the rear wheel and is driven



Whatever the speed of the motorcycle, this generator will keep the headlights evenly illuminated

from the engine by an endless leather belt. A voltage regulator controls the voltage of the generator at varying speeds and is so designed that full illumination is supplied to the lights when the motorcycle is traveling at six miles an hour.

Chemicals Render Zoological Specimens Transparent

MEDICAL students would have less difficulty in learning anatomy if it were possible to render an organ, such as the heart, transparent, so that all the veins and muscles in the interior could be seen in their natural position. Now M. Jezequel, for forty years a zoologist at the Sorbonne, has perfected a method by which flesh can be made transparent.

The specimen is dehydrated by immersion in alcohol, and is then carefully impregnated with methyl salicylate. After this treatment M. Jezequel claims that the

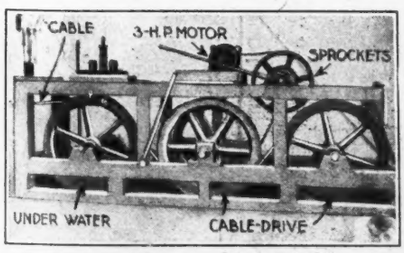
© Keystone View Company

M. Jezequel, inventor of a chemical process which makes flesh transparent

tissues become transparent, while the veins and arteries are plainly visible by reason of the coagulation of blood within them, which renders them opaque. The degree of transparency is said to depend on the purity of the methyl salicylate employed.

A Three-Horsepower Motor Drives Ferryboat

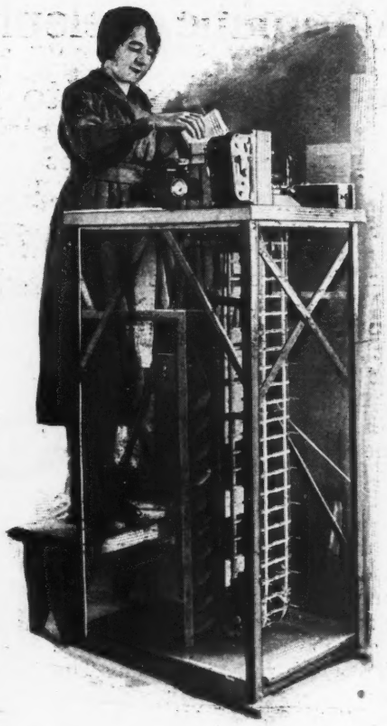
ON the Peedee River in North Carolina there is an electrically operated ferryboat that is controlled by a motor on board. The motor, which is of three horsepower, two hundred and twenty volts, is con-



A three-horsepower motor operated from an overhead trolley drives a ferry-boat across the Peedee River in North Carolina

nected by a series of sprockets with a cable-drive that enables the boat to cover a distance of seven hundred feet in two and a half minutes.

The ferryboat is large enough to carry eight automobiles at a time. It is equipped with a telephone that enables travelers to communicate with people on shore in case of trouble.



Census Returns Are Sorted with a Magnet

THE first step in tabulating census returns is to sort the miscellaneous information obtained in the field into its main headings. This would be an almost endless task if done by hand, but a magnetic sorting machine will handle 15,000 cards an hour, and never make a mistake.

The information is transferred to specially prepared numbered cards. In classifying men by their occupations, for example, the fact that a man is a printer is indicated by punching a hole at number 4; if he is a lawyer, number 5 is punched, and so on. The cards are then placed in the hopper of the sorting machine and from there pass down between a brush and a roller.

When a hole goes under the brush, a contact is made that operates an electromagnet. All the other chutes are held back by a pawl that is part of the armature of the magnet, and when the opening corresponding to the number punched reaches the card, it slides through into the proper compartment.

Plumber Turns Surgeon to Save Workman's Life

WHILE repairing an elevator, a workman in England was struck by a steel rod which entered at his shoulder and left by his knee, pinning him to the floor. After the man was freed by cutting the bar with a hacksaw, it was found that he had three and a half feet of steel tubing in his body. The surgeons had no tools for removing a body of this size, so a plumber was called in. He put on an operating gown over his overalls, sterilized a stilson wrench and a pair of gas pliers in the usual way, caught hold of one end of the rod and withdrew it from the wound without mishap. The victim recovered from this strange operation and is expected to live.

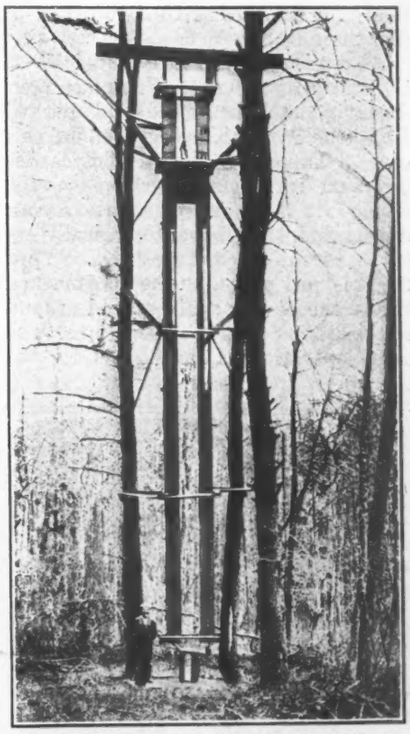
Sidecar Takes on Novel Shape to Advertise Shoe-Store

MOST Americans think that the rest of the world follows after them when it comes to advertising, and in the main it is true, but the picture above shows what our British cousins can do in that line.

A certain shoe-repair store owner in England utilized his sidecar for advertising purposes by having it built in the shape of a huge shoe with his name painted on.

Testing Depth Bombs with a Pile-Driver

EXPLODING depth bombs in the woods is the latest experiment tried by the United States navy. The bomb is placed between two trees to which a pile-driving outfit is attached in the manner shown below. The weight at the top is dropped on the bomb and it has the same effect on the bomb as water of a corresponding



Depth bombs are tested by dropping a heavy weight upon them from a great height

depth. The weight is dropped from varying heights and thus the effect of water pressure is found.

From these experiments in a forest near Tacoma, Washington, data are being obtained that will prevent accidents from the premature explosion of bombs.

How Your New Automatic Telephone Will Work

Nearly every home in America is going to be its own exchange

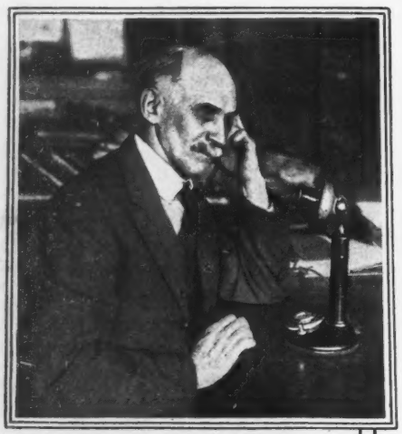
By Raymond Francis Yates

WITHIN a few years telephone operators will be as scarce as horse-car drivers. With automatic telephony, you have only to manipulate a dial at the base of the telephone. All kinds of little "jiggers" at the telephone exchange dance around rapidly, going about their task of connecting your line with the number you are calling. The number called is recorded, an idle trunk-line between the exchanges is found, the proper line is picked out at the distant exchange and the bell of the distant telephone is rung.

In place of giving the number to the operator, you will "dial" the number. The dial is located at the base of the telephone and by its use electrical impulses are sent to the telephone exchange which cause the mechanism there to perform certain functions.

To operate the automatic telephone you first lift the receiver from its hook and hold it to the ear. A certain tone is then sent through the receiver that will indicate that the instrument is ready for use. After that you start to dial the number.

Assume that Pennsylvania 5280 is the number you want. You place your finger in the hole in the dial marked PRS (the R and S are ignored in this case). The dial is turned in clockwise direction until your finger comes to the stop. At this point you remove your finger, and the dial automatically returns to the normal position. Your finger is next placed in the hole marked E and the dial is again moved around to the stop and allowed to return. The same operation is carried out for the letter N, and for the number. Only the first three letters of the exchange are "dialed." This makes seven times that the dial must be turned and allowed to return to its normal position.



After the call is dialed, the subscriber listens for a signal. If the line is clear, he hears the bell of the number he is calling. If the line is busy, he receives a "busy" signal

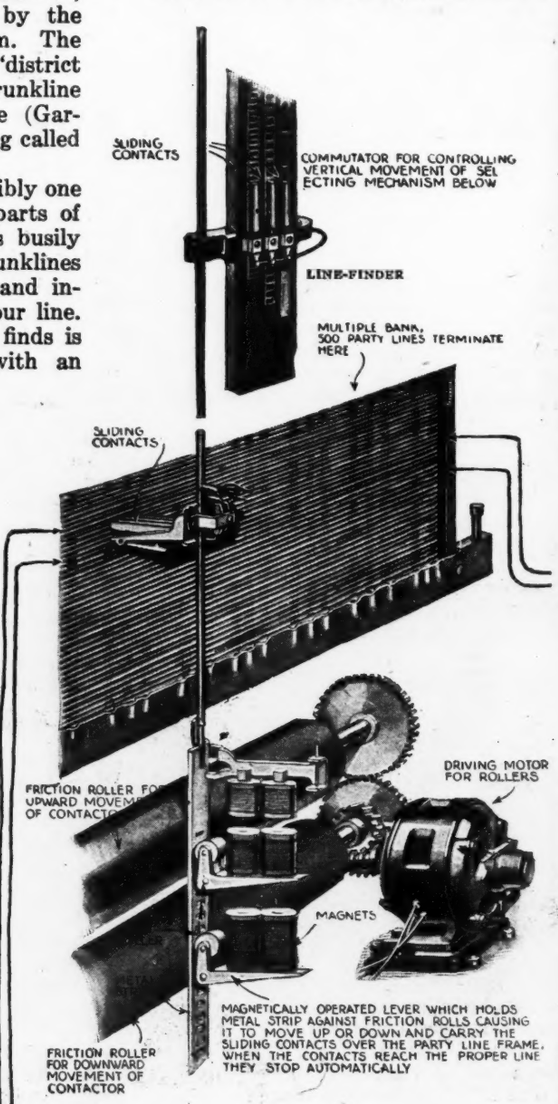
When you lift the telephone receiver from its hook, a number of little busybodies at the exchange get into action, select your line, and automatically connect it with an idle "sender." When this is done, you are notified by a gentle tone in the receiver. As you dial, the signals are received by the sender, which registers them. The sender then directs a "district selector" to find an idle trunkline between the first exchange (Garfield) and the exchange being called (Pennsylvania).

The district selector, possibly one of the most "intelligent" parts of the whole system, searches busily through hundreds of trunklines until it finds an idle one and instantly connects it with your line. The end of the trunkline it finds is connected automatically with an "incoming selector" in the Pennsylvania exchange. The sender that first recorded your number and found a trunkline for you, now continues its work and causes your line to be connected at the Pennsylvania office with the "final selector."

The actions of the final selector at the distant office is still controlled by the sender that you leased when you picked up the receiver.

At the final selector in the distant office, the line of whatever subscriber you are calling terminates, and it is the duty of the final selector to search quickly through the multitude of lines and find the one you are calling. At the very instant it is connected with your trunk-

The dial of the automatic telephone. It works like this: If you wanted the number, Garfield 225, you find the number printed in the book, "GARfield." This means that the letters GAR would have to be "dialed." To do this, the finger is placed in the hole containing the letters GHI. The HI would have nothing to do with the call. The dial would then be turned until the finger came to the stop and then it would be allowed to return. The same operation would be followed out for the AR and the numbers 225


SLIDING CONTACTS
COMMUTATOR FOR CONTROLLING VERTICAL MOVEMENT OF SELECTING MECHANISM BELOW
LINE-FINDER
MULTIPLE BANK, 500 PARTY LINES TERMINATE HERE
SLIDING CONTACTS
DRIVING MOTOR FOR ROLLERS
MAGNETS
MAGNETICALLY OPERATED LEVER WHICH HOLDS METAL STRIP AGAINST FRICTION ROLLS CAUSING IT TO MOVE UP OR DOWN AND CARRY THE SLIDING CONTACTS OVER THE PARTY LINE FRAME. WHEN THE CONTACTS REACH THE PROPER LINE THEY STOP AUTOMATICALLY
FRICTION ROLLER FOR DOWNWARD MOVEMENT OF CONTACTOR

All the subscriber lines of the automatic exchange terminate at what are known as the "final selector" and "line-finders." When a call is received, the selector faithfully and rapidly

line, the connection is completed.

When the connection is completed, you can hear your called subscriber being rung. When the bell is rung, a gentle humming noise is heard in your receiver. If your friend is not home, you hang up the receiver. If the line is busy, the final selector soon discovers the fact and a "busy" signal is sent back to you.

It is interesting to note the method of routeing a call if you happen to call some one in your own exchange. In such a case, the call is routed from the district selector in the office to the "final selector" in which the desired subscriber's line is located. At the instant the conversation is completed and the receivers are hung up, the entire mechanism used in making a call returns to its normal condition and is ready for another call.

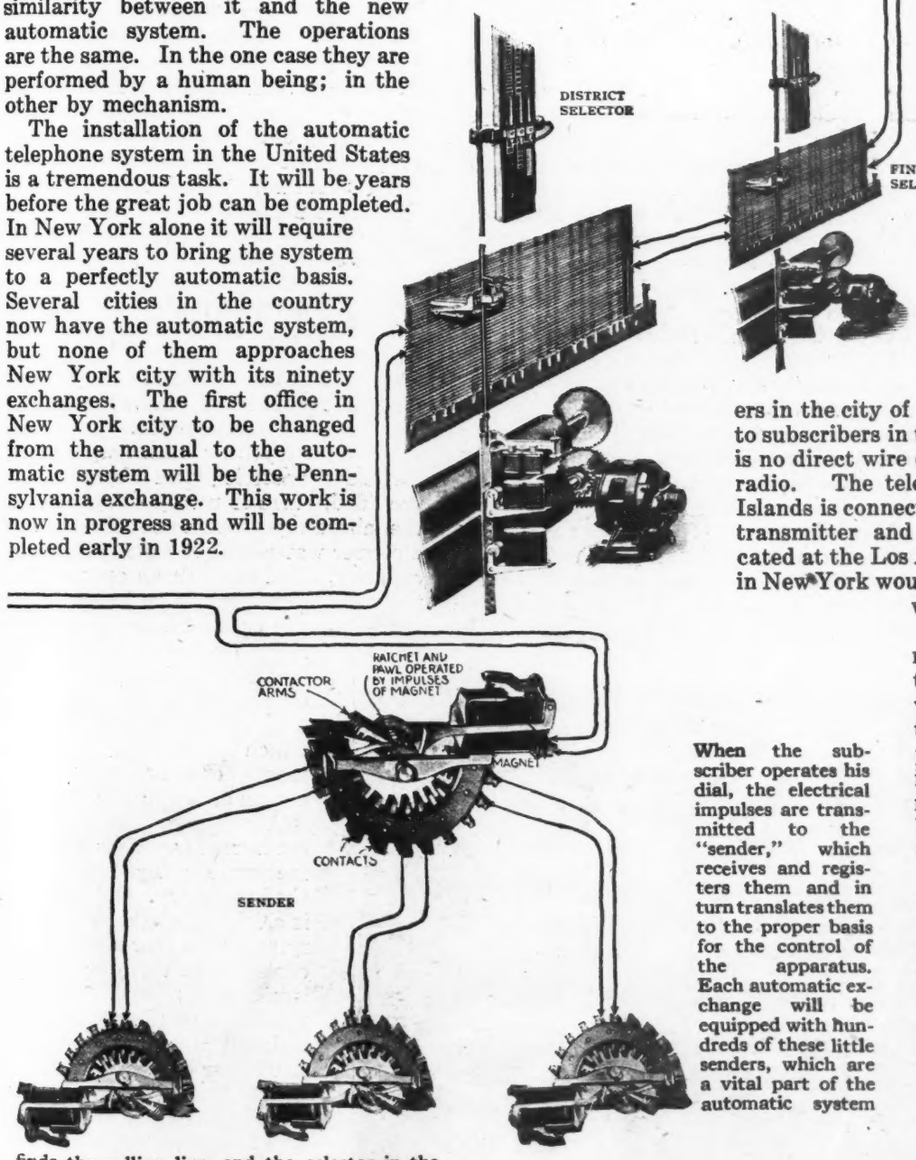
Since you are familiar with the present system of telephone operation you will immediately recognize the similarity between it and the new automatic system. The operations are the same. In the one case they are performed by a human being; in the other by mechanism.

The installation of the automatic telephone system in the United States is a tremendous task. It will be years before the great job can be completed. In New York alone it will require several years to bring the system to a perfectly automatic basis. Several cities in the country now have the automatic system, but none of them approaches New York city with its ninety exchanges. The first office in New York city to be changed from the manual to the automatic system will be the Pennsylvania exchange. This work is now in progress and will be completed early in 1922.

Some one will ask: "What would happen if a subscriber in an automatic exchange called a subscriber in a manual exchange? In such a case, the automatic apparatus would act in the same manner described above in finding a trunkline to the distant exchange. At the distant exchange, the number would be flashed on a "call indicator" before the operator, who would then complete the connection with the cord in the usual manner.

In just the opposite case—that of a subscriber in a manual exchange desiring to speak with a party in an automatic exchange—the number would be given to the operator in the usual way. The operator would then cause the automatic apparatus in the distant exchange to function by pressing certain buttons, which would be an operation similar to that of "dialing" a call. When the automatic apparatus had established a connection between the party being called and the operator, the operator would then complete the connection to the calling subscriber in the customary manner.

The bell of the receiving telephone is rung at intervals. If no answer is forthcoming, the receiver is hung up after a reasonable time has elapsed



finds the calling line, and the selector in the distant exchange takes the opposite end of the trunkline and connects it to the party line being called

When the subscriber operates his dial, the electrical impulses are transmitted to the "sender," which receives and registers them and in turn translates them to the proper basis for the control of the apparatus. Each automatic exchange will be equipped with hundreds of these little senders, which are a vital part of the automatic system

The world is about to enter upon a new telephone era. The past five years has prepared the ground for a complete revolution in present-day methods of communication. Within a few years' time we shall be able to pick the telephone receiver from the hook in our homes, and be connected by radio with any point in America or continental Europe.

To-day the telephone subscribers in the city of Los Angeles can talk by telephone to subscribers in the Catalina Islands, although there is no direct wire connection. The gap is covered by radio. The telephone exchange on the Catalina Islands is connected with a small but powerful radio transmitter and receiver, and this outfit is duplicated at the Los Angeles exchange. In fact, a person in New York would be able to carry on a conversation with a party on the Catalina Islands.

Probably in the future, when radio really comes into its own in telephonic communication, there will be a button on the dial bearing the word "Radio." When this is pressed, the subscriber will be placed in communication with a powerful radio telephone station, which will be capable of flinging the voice to the far corners of the earth.

The automatic telephone is in use in a number of cities in this country at the present time, but New York is faced with a job many times greater than that heretofore attempted in changing a city from the old to the new system of exchanges. There are over one million telephones in the city of New York and ninety exchanges are required to accommodate them. This is the greatest network of communicating wires in the world, and several years will pass before the big job of making a change is completed.

Famous Character Expert Analyzes Composite Portrait of America's Great Scientists

If your brow is narrow, head broad, eyes blue, and chin long, you have the typical features of the inventor

THE composite photograph of famous American scientists and engineers, shown on the opposite page, has been analyzed for Popular Science Monthly by Katherine M. H. Blackford, M. D., expert in character reading.

The significant features characterizing the inventive genius are the prominent, well modeled nose, the strong jaw, and the peculiar shape and breadth of the head (noticeable in the individual portrait of Thomas Edison). The immediate sign of the man-who-will-succeed lies in the long chin and square jaw, which indicate unusual resolution and tenacity.

"The general expression of this remarkable face," Dr. Blackford pointed out, "is that of a likable human personality. The mouth is sensitive as well as firm. This typical inventor is not one to be cranky or sour, or to fly into petty rages over trifles. He has hope, optimism, and faith.

"But one of the most striking things about the face is not evident in the photograph. Practically all of these men are blonds. Some of them have dark hair, to be sure, but nearly all have the blue or gray eyes. I should say that investigation would show 95 per cent of successful inventors to be blue-eyed men."

Notice the narrow brows, and that the head broadens above them until its greatest width comes at a point fully an inch above. Note especially the width of the head above the ears. It is this feature, chiefly, according to Dr. Blackford, which stamps this composite portrait as that of a scientist of the creative type.

Facial characteristics of the typical inventor

EYES Generally blue

NOSE Prominent

APPEARANCE Of force, kindliness, and confidence

FOREHEAD Remarkable for its width

MOUTH Firm and sensitive

CHIN Long, with square jaw

Traveling Laboratory Tests Small-Town Water and Milk Supply

MODERN public health service is dependent on laboratory determinations for much of its effectiveness in the control of contagious disease. The testing of water and milk supplies, and the examination of blood, sputum, and throat swabs are outstanding examples.

While this work is performed quickly and accurately in large cities, the work of doctors in small communities is handicapped because of the difficulty in getting the samples of water and milk to a laboratory without the danger of unreliable results due to changes in the condition of the samples.

The method heretofore in use was to put the samples in tightly sealed bottles, pack them in a box full of ice, and ship them by express to the city hospitals. This worked all right if distances were short and the box went through without delay. But frequently delays occurred. It is often very important to get results quickly so that the health authorities may make the necessary corrections at once. A few days' additional use of a contaminated water supply may turn a few scattered cases of typhoid into an epidemic.

In order to preserve health at the summer resorts of Michigan, it was decided to design and build a laboratory that could be taken to the place where it was needed. The result is the laboratory truck shown below.

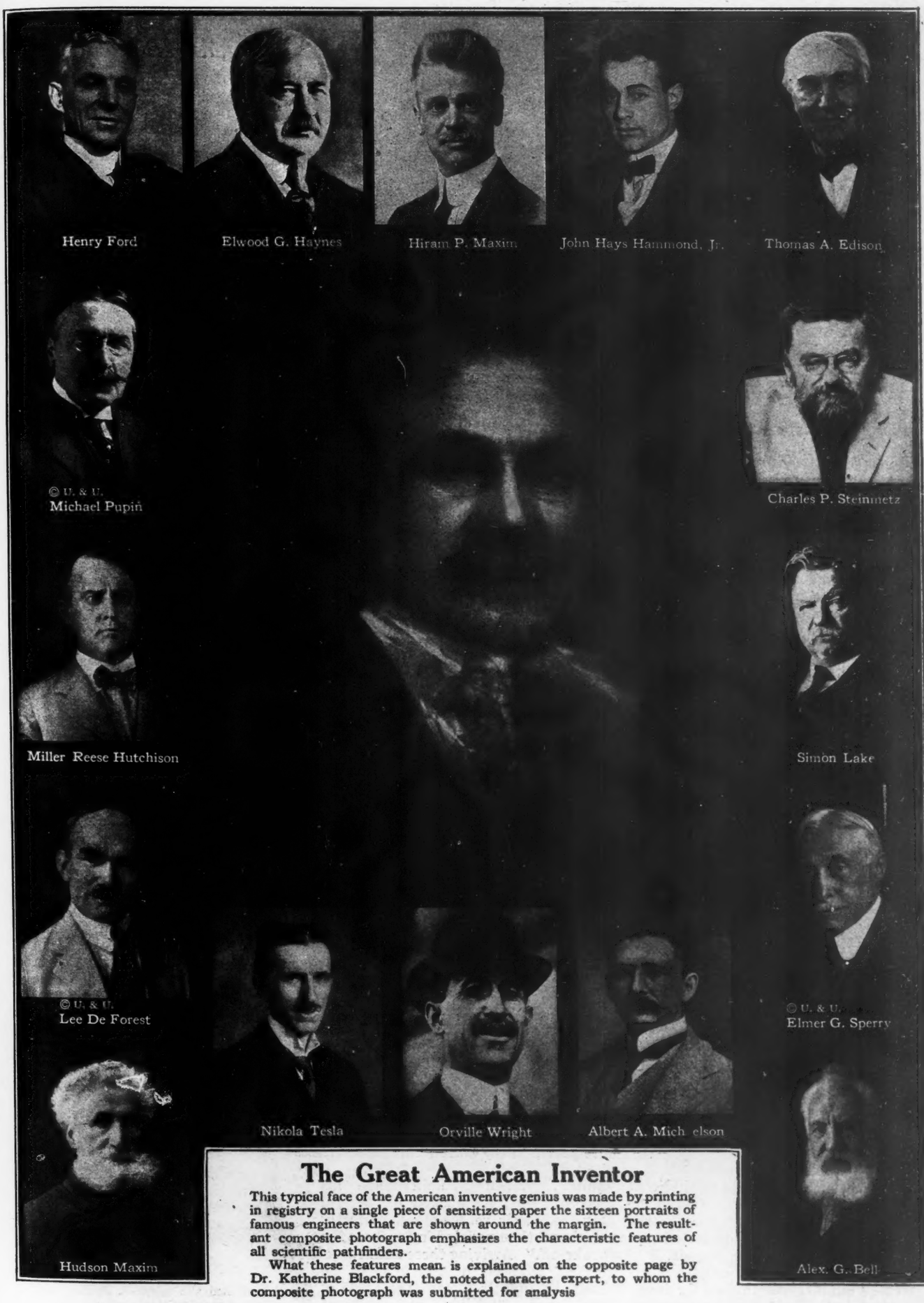
This consists of a light truck chassis with a special body which is a marvel of ingenuity in the arrangement of the space and in the provisions for taking care of the delicate glassware when traveling over rough roads.

While everything necessary to a first-class bacteriological laboratory is provided, there is plenty of space for the laboratory worker. At the rear is a copper water-tank of twenty gallons capacity, filled through an opening in the roof. The sink is on hinges and folds into the cupboard on the right. Near by is a compartment in which the sterilizer and other articles are kept, and three stacks of drawers in which glassware, instruments, etc., are packed in cotton or felt-lined racks.

A gasoline-operated Bunsen burner furnishes a satisfactory heating flame for the laboratory. On the left is a folding workbench carrying at the rear a pressure cooker to be used for steam sterilization, and underneath is a gasoline stove by which it is heated.

The car has seats for four people and room for baggage in the rear. A small tent is carried on the running-board and becomes the living quarters of the crew when a stop is made.

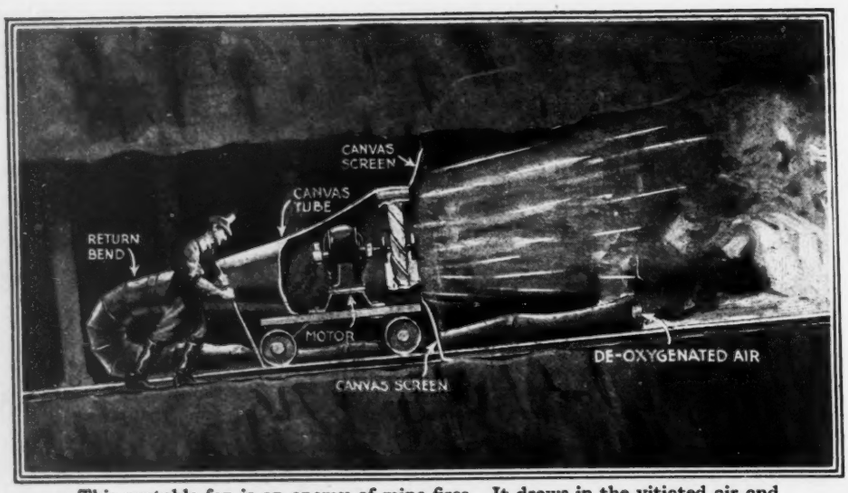
For health and sanitation in rural districts—a traveling milk- and water-testing laboratory



The Great American Inventor

This typical face of the American inventive genius was made by printing in registry on a single piece of sensitized paper the sixteen portraits of famous engineers that are shown around the margin. The resultant composite photograph emphasizes the characteristic features of all scientific pathfinders.

What these features mean is explained on the opposite page by Dr. Katherine Blackford, the noted character expert, to whom the composite photograph was submitted for analysis



This portable fan is an enemy of mine fires. It draws in the vitiated air and drives it under pressure against the blaze. Canvas strips extending from fan to mine roof prevent the entrance of fresh air from the outside

Mine Fires Extinguished with Blast of Dead Air

FIGHTING a fire underground with the aid of a ventilating fan is a hitherto unheard-of procedure, but the method has been adopted by a copper-mine in Arizona to control air currents while fire-fighters are quelling a subterranean blaze. The greatest difficulty and the principal danger in fighting fires in metal-mines has lain in the clouds of dense smoke and poisonous gases that prevent firemen from reaching the seat of the blaze.

The fan used is a 36-inch disk blower, mounted on a truck and run by a one-horsepower, 220-volt motor with a speed of 510 revolutions a minute.

The capacity of the fan itself is 6700 cubic feet of air a minute. The fan and motor occupy a position slightly offside the center of the truck, the protected shell of the fan being flush with the end of the carriage. Attached to the shell of the air-circulating medium is a square strip of canvas fitted with automobile-curtain fasteners, and lying loosely on the truck are several similar pieces. Having fastened these curtains together, securely staked to the nearest timber set, they constitute an effectual cloth stopping, with the fan in the center. Wire connections are available for linking the fan to a convenient electric circuit.

By suitable location of stoppings, constructed of canvas or similar cloth, the emergency fan can be coaxed to surround the area of the blaze with a blanket of gases, low in oxygen and high in carbon dioxide, which have been generated by the fire itself.

Repairing Chair-Seats while You Wait

A PADDED chair-seat that can be purchased as a complete unit and installed in a minute's time might well be called the upholsterer's enemy. An inventor who lives in New York has succeeded in perfecting a chair of this description.

As will be seen by the illustration,

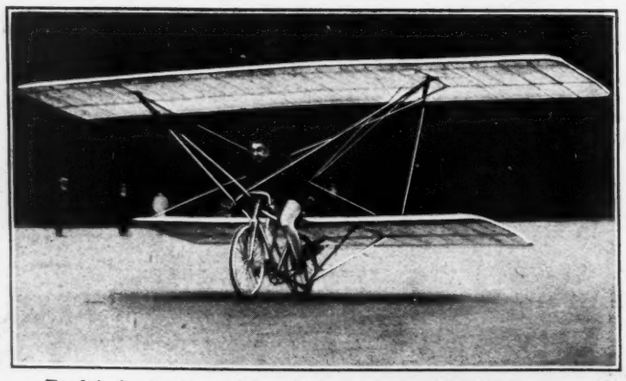
A strip of wood, two screws, and a screw-driver make this chair as good as new

the seat with its wooden base and its padded cover is accompanied by a crosspiece with screw-holes already provided. The seat is placed on the chair; the crosspiece spans the chair sides, and the two screws finish the job.

For the father of a family of growing children, this is a wonderful money-saver in the never-ending task of renewing broken furniture.

Flies Thirteen Yards in Plane Propelled by His Feet

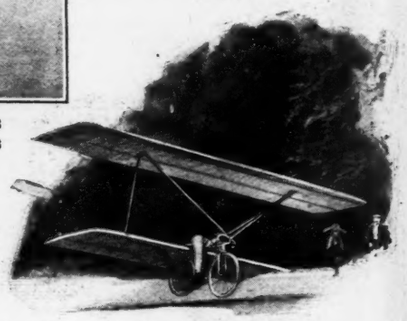
AFTER many attempts, several of which were almost successful, Gabriel Poulain, a Frenchman, has finally succeeded in winning the famous Peugeot prize of ten thousand francs offered to the first person who could fly a distance of ten yards in a motorless plane. Poulain's prize-winning "hop" spanned a distance of about thirteen yards.



Poulain lands after gliding thirteen yards with his legs as the motive power, thereby winning ten thousand francs

The aviette consists of a common bicycle on which two planes are attached. One of the wings is fastened to the seat and the other to the front frame of the bicycle. The area of the wings is about 175 square feet and the weight of the machine complete is approximately thirty-seven pounds.

The operation of the aviette is extremely simple. An unusual leg development is the only motive power required. When Poulain made his record flight, he backed off several hundred yards, set his planes perfectly level and then pedaled furiously to the "take-off." Arriving there and traveling at a speed of thirty miles an hour, he slightly altered the angle of the planes. This lifted first the front and then the rear wheel from the ground. The total weight lifted by the aviette was said to be in the neighborhood of two hundred pounds. It has been figured that the muscular energy required for a flight of this nature is close to three horsepower.

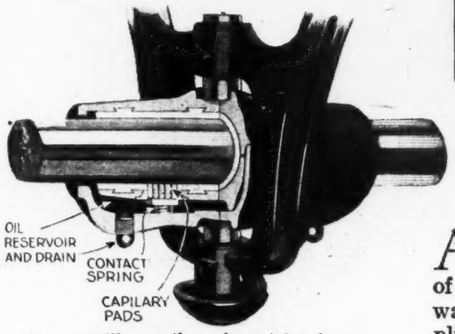


As he reached the take-off, Poulain had attained a speed of thirty miles an hour

Capillary Oiler Prolongs Life of Bearings

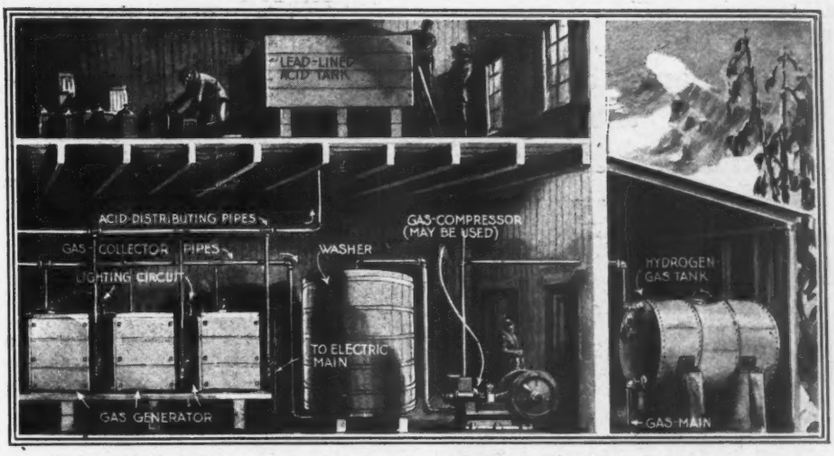
THE increasing use of capillary, or "wick," oiling devices is steadily eliminating lubrication troubles in connection with bearings of all kinds.

In a device of this sort, the oil stays at rest in a comparatively large oil reservoir, and is not agitated by the motion of the bearing. The wicks draw the oil only from the surface, so that any moisture or dirt that may be introduced accidentally, settles to the bottom and never comes in contact with the working surfaces.



In a capillary oiler, the wicks draw a constant supply of fresh oil from the reservoir to the bearing

The capillary pads act like small lamp-wicks, and are held against the surface of the shaft by a spring. The oil is drawn up only as fast as required.



With all fuels gone and only acid available, a Canadian engineer built this hydrogen-gas producing plant to furnish heat and light

Generates Heat and Light from Acid

A FRONTIER post in northern Canada was faced with a shortage of coal, kerosene, and gasoline. There was no chance of getting in new supplies for four months or more, but the owner, Mr. P. d'Aigneaux, remembered that there was a large quantity of acid in store, and after a little thought and experimentation, he improvised the acid power plant shown in the sketch.

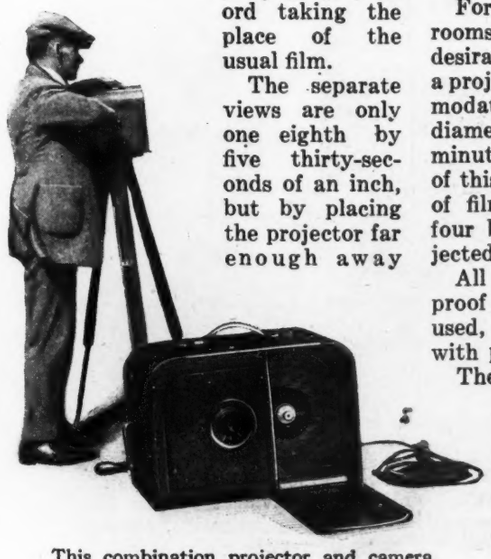
The source of power consisted of sixteen continuous hydrogen generators of suitable size, each formed of a tight lead tank for the acid. The gas produced was washed, and enough hydrogen was generated for heating and cooking and to run a six-horsepower stationary gasoline engine, using an explosive mixture of hydrogen and air instead of the gasoline-air mixture. Finally, by treating each generating-tank as an independent electric battery, enough current of low voltage and large amperage was produced to operate the electric lighting.

Later a smaller unit of the same nature was installed on a tugboat. It occupied no more space than the bunkers and boilers.

Camera Photographs Movies on Disk and then Projects Them

WITH the intention of supplying a motion-picture machine to enable the amateur to take and project his own pictures at a minimum of cost, a firm in Ohio has designed a combination camera and projector, with a disk similar to a phonograph record taking the place of the usual film.

The separate views are only one eighth by five thirty-seconds of an inch, but by placing the projector far enough away from the screen, they may be enlarged to life size. In the amateur equipment there is a sufficient number of views to provide a picture of three-minute length. By means of special developing equipment the user may develop his own disks rather than send them to a professional laboratory.



This combination projector and camera uses a nine-inch disk instead of a film

For industrial plants or exhibition rooms, where a longer picture might be desirable, the same firm has developed a projecting machine capable of accommodating a disk eighteen inches in diameter. A sufficient number of the minute views may be placed on a disk of this size to equal one thousand feet of film. With this outfit a picture four by six feet in size may be projected a distance of fifteen feet.

All the parts are enclosed in a fireproof housing and as only safety film is used, the machine may be operated with perfect security.

The inventors are also working on a synchronizing device to be used in connection with this disk machine that will make it possible to add a phonograph talking feature to the picture disks. In the past, talking pictures have been considered a unique accomplishment, suited only to special exhibitions, but with this device it is hoped to make them available for the home and school.

For home and school use, the eighteen-inch disk provides amusement for fifteen minutes

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly

On request, the Editor will be glad to furnish the names and addresses of manufacturers of devices shown in Popular Science Monthly

This Dumb Auctioneer Permits Silent Bidding

KEEN competitive bidding marked the first butter auction to be held in Berlin since the war, but you could have heard a pin drop at any time. It was a silent auction, and the auctioneer was not a man, but a machine invented by Harry Voight.

A huge dial was placed in plain sight of every bidder. The outer circle was divided into a hundred parts, numbered to correspond with the marks bid, and the center of the circle was occupied by a huge electric annunciator. Attached to the desk in front of each buyer was a miniature dial whose figures corresponded to the big one on the wall.

As soon as a buyer wished to bid he turned the pointer of the dial on his desk to the figure he desired to offer. The pointer of the big dial marked the same sum, and a flashing light on the annunciator indicated the seat number of the buyer bidding.

New Pastry-Cutter May Be Bent into Many Shapes

WHETHER it be a convention or a child's birthday party, this initial-cutter does its bit in making of the occasion

With this pastry-cutter an infinite variety of letters and designs may be worked out

or the person something extra special. Besides the actual initials, of course it is simple to work out all manner of designs.

The shape of the cutter is shown in the illustration. There are smaller cutters that are suitable for cutting initial noodles.

Moist Drying of Vegetables Retains Their Flavor

BY means of the moist-air process of dehydration recently perfected, you can carry home a bushel of potatoes as easily as the evening paper and eat fresh peach-pie throughout the peachless winter months.

Drying food is probably the oldest method of preserving, but in virtually all

A number of shallow trays over a gas-burner dry the vegetables without destroying their flavor

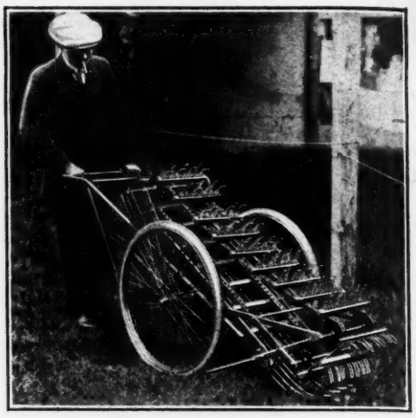
the old processes, the dehydrating factor has been warm dry air. Inseparable from this has been a hardening and rupturing of the food cells that permitted the escape of much of the flavor, color, and aroma. Although the dehydrated foods were very convenient, they failed to regain the attractiveness of their fresh state when cooked.

Extensive tests made with the moist-air dehydrator are said to demonstrate that food can be preserved so perfectly that connoisseurs cannot tell dehydrated food from fresh.

The apparatus for moist drying is an ovenlike device of sheet aluminum that fits over a stove-burner. Twelve shallow trays for holding food fit into the device like shelves. Beneath them and directly above the source of heat is a water-pan. The sides are pierced at the bottom with air vents.

As dehydration progresses, air enters the vents, passes over the water-pan for humidifying, rises through a pyramidal-shaped central region, and branches right and left among the food trays. Openings are provided to permit its escape through the top.

Drying by slightly moistened air does not rupture the walls of the food cells, and although the water is slowly withdrawn through their membranous structure, the cell walls retain every quality of nutriment and flavor. Savings in weight and bulk range from 15 to 92 per cent.



Picks Up Thirty Pounds of Apples a Minute

THE fruit-rancher must have a large orchard for this mechanical apple-picker, or the job of gathering the windfalls will be over before he realizes it has started. On the large ranch, it makes a task that was once a slow, backbreaking job a positive pleasure.

The machine picks up every apple lying on the ground as fast as it can be wheeled along, and if the apples lie thick enough it will handle thirty pounds a minute, all without bruising or damaging the fruit.

Artificial Rain Produced by Pump on Truck

HERE is a real rainmaker, concerning whose efficiency there can be no doubt. It provides refreshing showers for the sugar-cane plantations of Portuguese East Africa by carrying water from gigantic tanks to sprayers high above the cane.

The tanks supply the artificial rain at the rate of twenty-two hundred gallons an hour, which is fast enough and heavy

Growers of sugar-cane use this truck to throw water high in the air over the plants

enough to make the planters independent of the weather. Better results have been obtained by having the water fall from a height than by irrigation, since it is important to wet the stalks as well as to supply the roots with moisture.

With his grinder set up on the handle-bars this itinerant gets his power from the rear wheel

Workman Drives Scissors-Grinder from Bicycle

THIS scissors-grinder decided that knives get dull in the suburbs just as rapidly as in the city, and mounted his grindstone on his bicycle so that he could cover a large territory cheaply and grind by power at the same time. He worked out the attachment himself.

When he gets a job, the rear wheel is raised by a folding motor-bike stand. The grindstone is mounted on a stay between the handle-bars and the power is transmitted by a belt from a spindle soldered to the spokes of the rear wheel.

RAILWAY-CARS of reenforced concrete is one of the patent applications filed at Washington.

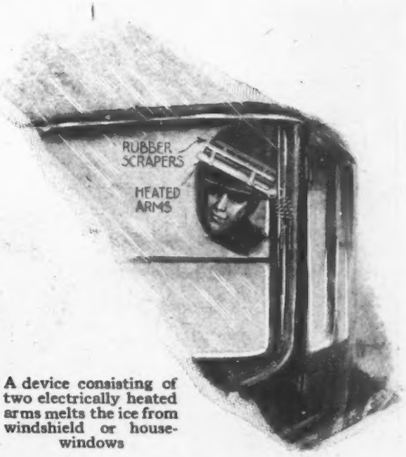
Mechanical "Cop" Flashes Light Eighty Times a Minute

FLASHING eighty times a minute, day and night, this mechanical traffic policeman with its acetylene lamp guides the traffic around the busy crossing near the southeast gate of the White House in Washington.

It has been found that drivers are less liable to overlook a flashing light than one that burns steadily. The lamp is similar in principle to the flashing acetylene buoys used to mark the limits of shoals in seaports. It will run for six months without attention. The lamp throws a green light.

© Harris & Ewing

An illuminated "silent policeman" directs traffic for six months without attention



A device consisting of two electrically heated arms melts the ice from windshield or house-windows

Cleaning Ice-Covered Windows by Electricity

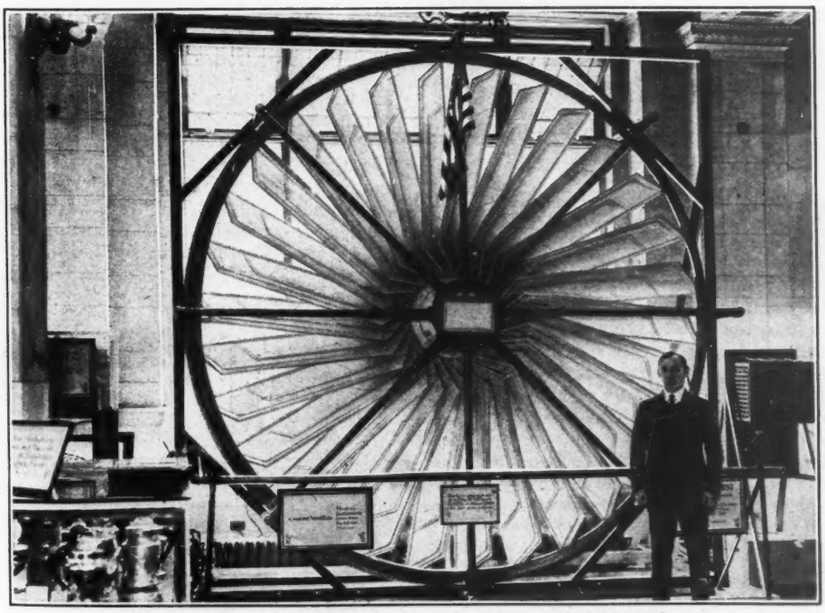
"WHEN icicles hang by the wall" you can be sure that they are hanging by the window too, and that the outside of the window is most likely covered with ice. How can you remove this ice while the cold weather persists? Use one of the new electric window-cleaners recently invented by A. L. Conkey, of Hartford, Michigan.

It consists of two electrically heated arms that fit against the inside and the outside of the window-pane, and that can be moved up or down. Rubber wipers follow the arms and gather in the drops that escape them. The heat of the arms will melt the hardest ice and snow. Current is supplied through any ordinary socket.

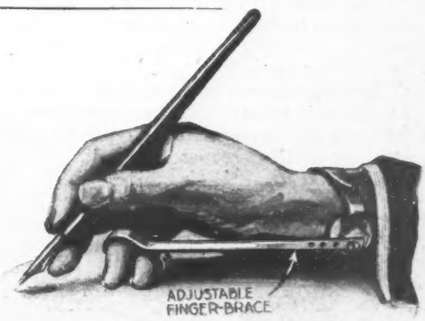
Displacing 150,000 Cubic Feet of Air a Minute

EVEN this twelve-foot fan will hardly produce an artificial typhoon, for in a real tropical hurricane the wind velocities are eighty miles an hour and upward. It does set up a wind that the most hardened sea-dog would admit was a "fresh breeze."

Run at its full speed of 125 revolutions a minute this gigantic fan will move 150,000 cubic feet of air at the rate of a thousand feet a minute, which is just about the speed of the wind that the sailors call "fresh" and the meteorologists designate as "force 5 on the Beaufort scale." The fans are built for the ventilation of theaters and other large public buildings.



This twelve-foot fan will change the air in theaters every three minutes

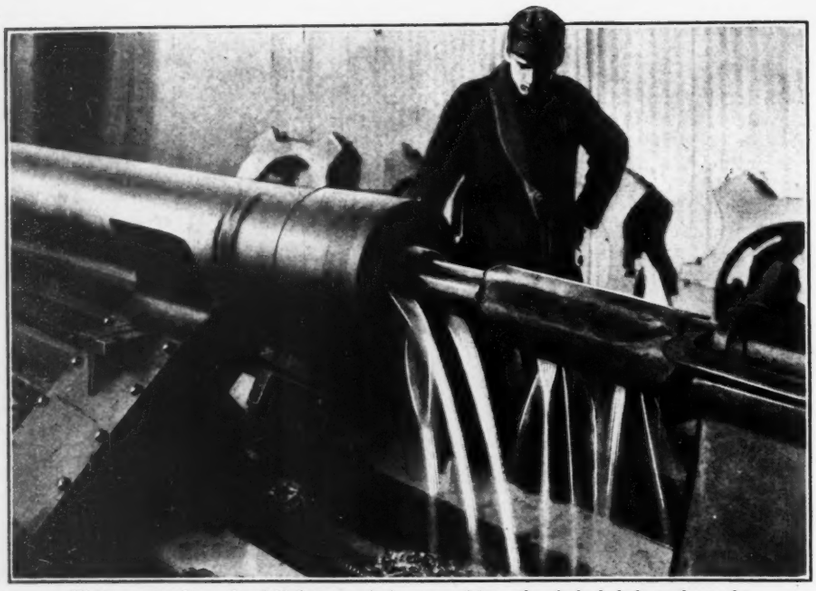


A Wrist-Clamp Will Prevent Writer's Cramp

THE inventors of this apparatus for writing correctly say that it will also prevent writer's cramp, so that it is as useful for the accomplished writer as for the student.

The largest part of the apparatus is a wristband threaded through a circular plate, to which is screwed the adjustable steel strap that has the clip at its extreme end. It is this clip that holds the third and fourth fingers in their correct position, supporting the hand, while leaving the thumb, index, and second fingers free to hold the pen.

SPUN glass possesses advantages over fine sand in oil-refining filters. It is less liable to destroy barrels by abrasion or clog tubing. Filtering through spun glass at Bayonne, New Jersey, increased the minutest water globules to the size of a pea, making dehydration easier.



Water spurts from the drill-flutes as it is pumped into the six-inch hole to keep the tool cool. This forging will be a propeller-shaft when completed

Lathe Bores Six-Inch Hole in Propeller-Shaft Forging

THIS lathe is boring a hole six inches in diameter in the center of a forging that will become a propeller-shaft for one of the newest of the United States navy's torpedo-boat destroyers.

The shaft is made hollow to save weight without sacrificing strength. A powerful pump is used to throw jets of water on the face of the boring-tool to prevent it from overheating.

Motor-Driven Sandpaper Machine Smooths Hard-Wood Floors

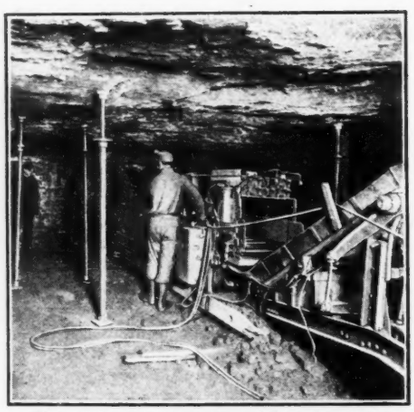
STUDY the picture carefully and note the compactness of the little machine that will polish newly laid hard-wood floors better and in less time than could possibly be done by hand.

The platform supports a motor, which is attached by a chain to the wheels and by a belt to a suction pump that gathers up the sawdust and sandpaper dust. The motor is also attached by chains to the rollers that carry the sandpaper. As soon as the floor is laid, a heavy sandpaper is put around the rollers, the machine is run diagonally across the boards, and in this manner the floor is very quickly evened up.

This machine smooths hard-wood floors with a motor-driven sandpaper roll. A vacuum-cleaner attachment gathers and holds the fine sawdust produced

Then the machine is run along the grain of the wood with a finer sandpaper around the rollers and the floor is given a polish that leaves it all ready for waxing.

FRESH-CUT tulips were sent by airship from Holland to London and from thence to Manchester, where they were sold the same morning.



The pick and shovel are missing from this coal-mine equipment. Vertical shears cut the vein and a conveying belt carries the lumps to the cars

Machine Cuts, Breaks, and Conveys Coal to Car

WHERE the new coal-mining apparatus invented by Nils D. Levin, of Columbus, Ohio, is employed, the miner may keep his hands clean and never has to touch pick or shovel. The machine cuts the seam, breaks down the coal, and delivers it to the cars that carry it to the pithead.

Two vertical shear-cutting mechanisms mounted on a carriage are arranged to cut vertical cuttings, while a third drives a horizontal groove. The coal is then broken down by reciprocating pick devices and falls on top of an endless conveyor-belt, which carries it back and dumps it into the car.

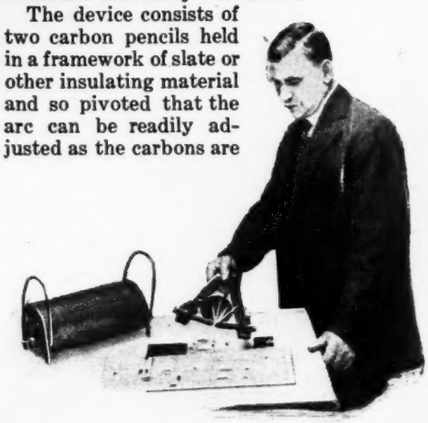
All the miner has to do is to keep the machine against the face of the coal-seam and oil the bearings, thus rendering his once arduous job comparatively easy.

This New Blueprinting Machine Eliminates Printing-Frame

THE inventor, Edward Hirt, is operating a device by which blueprints may be made without the use of the bulky printing-frame, even without removing the tracing from the drawing-board. Simply slip a piece of blueprint paper under the tracing, place a sheet of glass over the top, and pass the small arc over the section of the drawing you wish to reproduce. Develop in the usual way.

While working as a draftsman for a small concern, Mr. Hirt often found it necessary to take prints in a hurry, or to get small detailed parts from a large tracing for estimating purposes. This necessitated either sending a large print, or cutting out the part which was really needed. The portable blueprint machine was invented to eliminate this delay and waste.

The device consists of two carbon pencils held in a framework of slate or other insulating material and so pivoted that the arc can be readily adjusted as the carbons are consumed. A small reflector concentrates the light on the print-paper. To operate the machine, plug into the electric-light socket and attach the resistance coil, on the top of which wet blueprints can be dried. Then bring the carbons together, and instantly separate them. The proper arc is secured when the points are about three eighths of an inch apart.

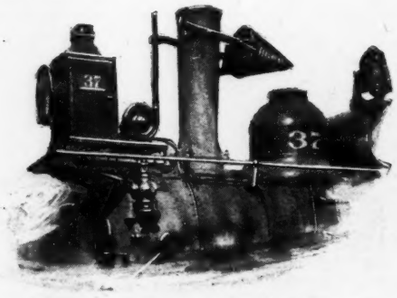


An arc held in the hand and passed rapidly over the drawing does away with the blueprinting frame

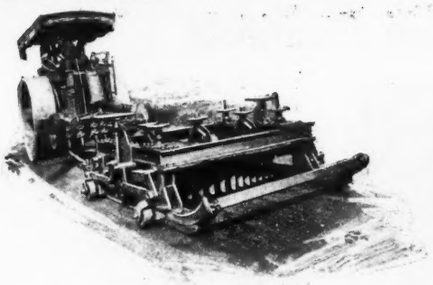
Foresters Test Spark-Arresters for Locomotives

IN the past five years engine sparks have caused 12 per cent of all forest fires in the woodland reservations of Uncle Sam. The Forest Service is conducting an investigation to determine the most effective type of screen to prevent the tremendous loss resulting from six thousand blazes annually.

The type shown is cheap, adjustable, and efficient.



The spark-arrester is tipped back when the engine is not in the woodlands



This road equipment embodies all the tools needed for road construction and repair

Road Tool Combines Drag, Planer, and Scarifier

A NEW machine, a combination drag, planer, and scarifier, which is adapted to work on hard-surfaced roads, has recently been placed on the market.

Constructed entirely of metal, it weighs three and a half tons. It may be drawn by tractor or steam-roller, being mounted on runners equipped with removable cast-iron shoes. Upon these runners is mounted an oscillating iron plate, holding the planer knives and scarifying chisels or picks, all adapted for adjustment by hand-operated screws to meet the varying road conditions.

Floating Cover on Oil-Tank Prevents Fires

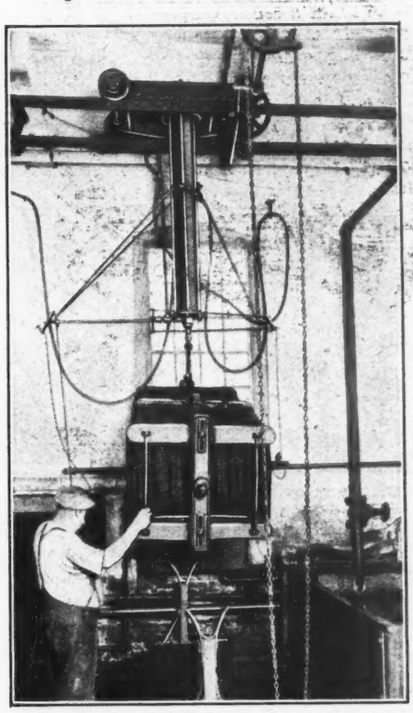
IT is claimed that this steel roof, which fits inside an oil-tank, supported by the surface of the oil, will prevent evaporation and make the tank absolutely fireproof.

The inventor tested the fireproof qualities of the tank cover by building a fire on it

The roof practically floats on the oil, as the edge is formed of a flexible element filled with gravel that conforms to the irregularities of the tank and makes it impossible for air or gas to enter.

F. W. Keuffer, of Los Angeles, gives a striking demonstration of the fireproof qualities of a tank protected by his "roof." Rubbish saturated with gasoline is piled both inside and outside the tank. When it is ignited, flames rise to a height of thirty feet, and the heat is so intense that the oil beneath the floating "roof" frequently reaches the boiling-point, but the fact that the air is shut out makes it impossible for the oil to catch fire.

Inexperienced Workers Can Operate Pneumatic Hoist



Complete control of this pneumatic hoist is exercised by two ropes, one in each hand of the worker

IT is quicker to turn a valve than to operate a chain-hoist. Moreover, the pneumatic hoist does not waste the time of a skilled and highly paid mechanic in operations that any laborer could perform. This pneumatic hoist is absolutely positive in action and its speed of operation makes it the most economical means of handling light- and medium-weight material in factory or garage.

At the call of fire, the first automobile hooks on to this chemical trailer and hauls it along

Chemical Fire-Engine Trailer for Small Communities

IN rural communities the wooden buildings and the absence of fire-escapes make the danger of fire serious, but many towns cannot afford the expense of an automobile fire-engine. When a fire breaks out, horses must be driven from their work or from a livery stable to the fire-house before the alarm can be answered. While these valuable minutes are being wasted, sightseers have driven their private autos to the fire at thirty miles an hour, and are waiting impatiently when the engines gallop up.

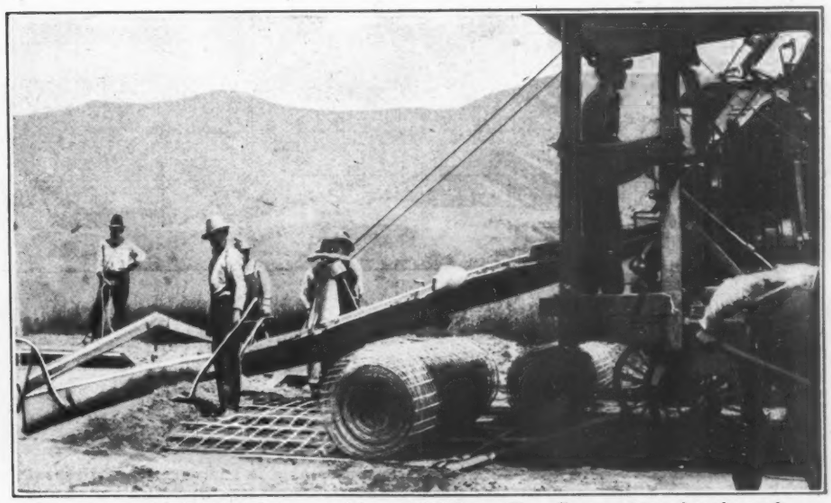
Why not have one of these automobiles pull the fire-engine? The trailer illustrated can be attached instantly to any car. It is equipped with the chemical fire apparatus recommended by Fire-Chief Croker of New York City, and by taking advantage of the ubiquitous automobile, the smallest village can have an efficient fire department busily putting out the blaze within a few minutes after the alarm has been turned in at the fire-box.

IF you keep your garden tools in a round wire trash-burner, you will know where they are and the yard will always be tidy.

Hog Wire Used to Reenforce Concrete Highway

ON some of the slight grades of California roads or on level stretches where the engineers believe this sort of reenforcement to be needed, double rolls of extra heavy hog wire, heavily galvanized, are used to strengthen the roadways.

The wire is laid on a special framework of pipes in order to bring it into the correct position for the concrete to be poured under and around it. This framework is drawn forward with the mixer and as it moves the rolls of wire are unrolled with it.

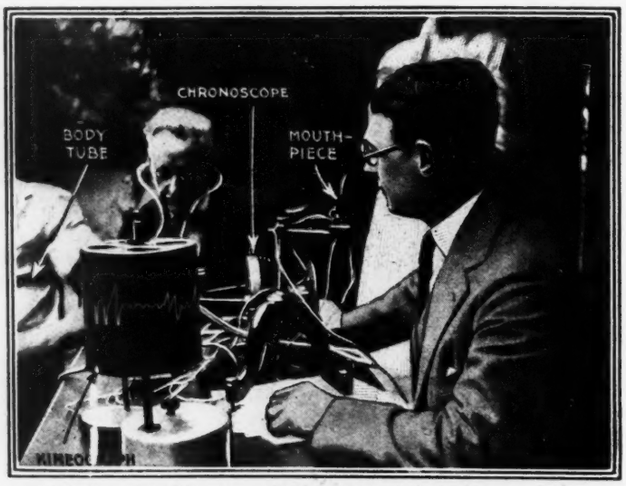


Hog wire, well galvanized, is now used in road-building. The rolls are unwound as the work proceeds, pipe-spacers holding the strands in the center of the mixture

This Machine Forces Confession from Criminals

PEOPLE may tell a lie and show no outward signs of it; but internally—through the heart and lungs—they betray themselves. We now have a machine, invented by William M. Marston, of Boston, that finds its principal use in recording the heart and lung action of suspected criminals as they are cross-examined. There are three separate parts to the machine—the chronoscope, the kimeograph, and the sphygmomanometer.

The chronoscope measures the time that elapses between the examiner's question and the suspect's answer. There is a mouthpiece in front of each man. When the examiner asks his question, the chronoscope automatically starts to whir and continues until the suspect answers. The interval between question and answer is measured in twelve hundredths of a second. Usually the examiner reads off a prepared list of words, one by one. The suspect is told to reply with the first word that comes into his head. Some of the words in the examiner's list have nothing to do with the case. Others refer directly to the crime in question. If the suspect is guilty, he will invariably hesitate—perhaps for only a few hundredths of a second—before replying to a "crime" word, because the first word that comes to his mind is usually one that bears on the crime and he must hunt for another one. The innocent man will respond to all words in approximately the same interval of time.



William M. Marston, the inventor, takes charge of the mechanical cross-examination of a suspect. On the table are the three mechanisms used in the test. The drum in the foreground contains a record of the suspected man's breathing

Next there is the kimeograph, which records the suspect's breathing. A rubber tube is fastened around the man's chest and is compressed slightly at each breath. The tube is connected with a revolving drum in such a way that a zigzag line is drawn on the drum at each breath. When a man lies, he breathes differently. You might not notice it, but the kimeograph does; the zigzag lines take a new course when he lies.

The sphygmomanometer registers blood pressure. It is attached to the man's arm and is connected with a stethoscope that is operated by a doctor. He and the examiner have a system of signals that tell him when to record the pressure. First he finds the average pressure of the man when he is being asked inconsequential questions. If his blood pressure increases whenever he is asked questions that refer to the crime, indications point to his guilt.

If the lady tells a lie, her breathing will reveal it. The tube around her chest is affected by the slightest change in lung action

If guilty, the suspect will hesitate in answering questions regarding the crime. The chronoscope records the time required for the reply

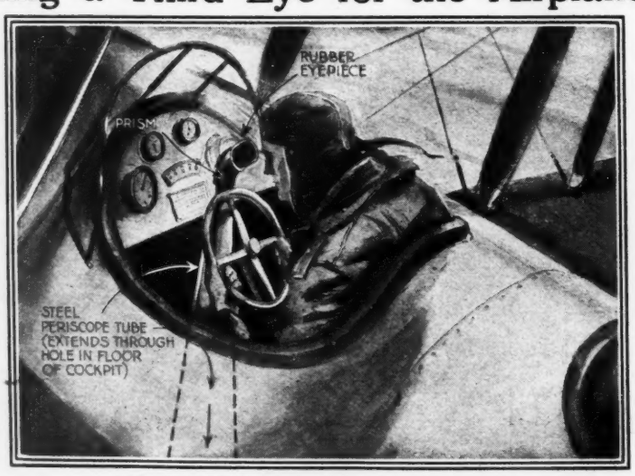
Providing a Third Eye for the Airplane Pilot

A NEW type of periscope has been invented to do away with the "blind spot" in airplanes. Without this invention, in the average plane the pilot has a clear view ahead and a fair view on both sides, but he cannot gaze directly earthward unless he turns and leans over the side.

He could do this in the older, slow machines; but in the giant planes of today it is difficult, if not impossible.

With the intention of correcting this deficiency, engineers have adopted an old wartime instrument, the periscope, and combined it with the control lever or what is known in aeronautical parlance as the "joy-stick."

The "third eye" is made of thin sheet steel in the form of a cone. Near the top, and just beneath the rubber-faced eyepiece, the steering-wheel is mounted. Immediately below the eyepiece is a right-angle prism that reflects the image of the ground over which the plane is passing. The ailerons and rudder are controlled by moving the entire telescope tube fore and aft, similarly to the manipulation of the "joy-stick," or control lever.



A periscope placed in the control column and running down through the cockpit floor provides the pilot with a view of the ground below

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly

Selling Land and Buildings from the Air

Airplane photography opens up a new medium for the real-estate salesman

LESSONS learned in aerial photography during the war are showing results in their rapid application to commercial use. There are firms that make a specialty of taking airplane views of factories or of communities. Manufacturers have discovered that a genuine air photograph gives a more comprehensive idea of the plant, the location of the buildings, and the general layout than any number of ordinary views taken on the ground or even on a tower.

But the most interesting application of airplane photography is its growing use as a selling force in the real-estate business.

This air photograph gives a customer a better idea of the property than any number of ground views

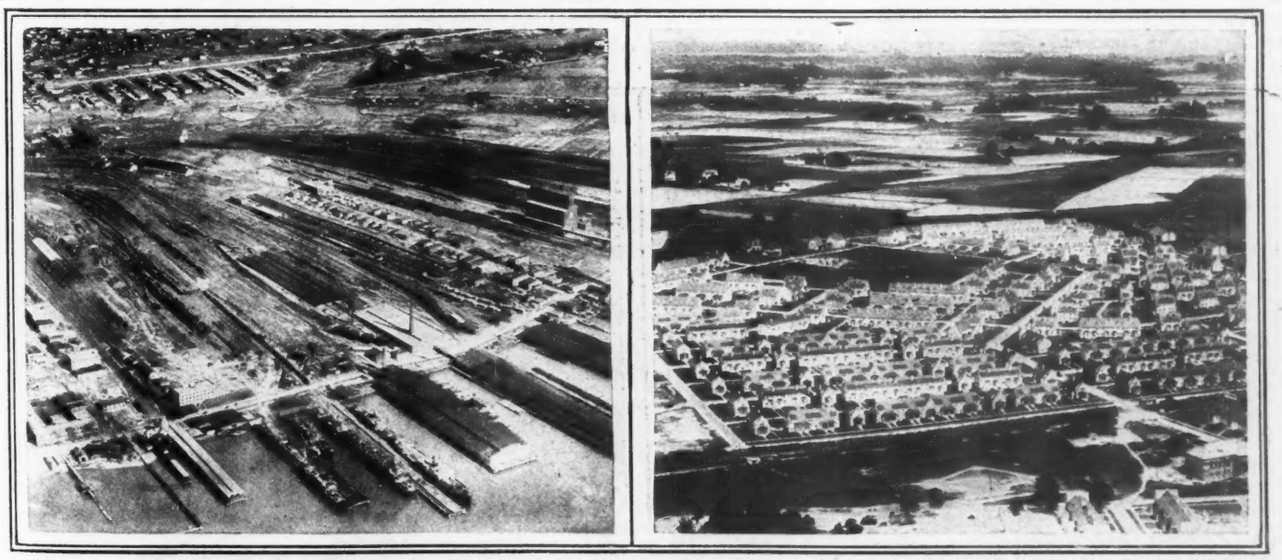
Real estate is a difficult thing to sell. An automobile, for instance, may be easily viewed as a whole. The prospective purchaser, if he chooses, may look on three sides of it at once or, by walking around it, obtain an impression of the entire car.

But the real-estate man is up against it. When Mr. Smith walks into the office and announces that he is thinking of buying a "home of his own," the salesman starts at a disadvantage. He commences by describing roughly and usually inaccurately the various properties that might interest Mr. Smith. Sometimes he even goes so far as to show Smith some photographs of the houses.

But Smith is a bit wary. He can not tell from the photographs whether the property is on a respectable street or whether it is hedged in by factories and small shops. So that, after all the salesman's talk, it is necessary to take Mr. Smith to every one of the properties. Too often, when he gets there, one glance is sufficient to tell him that it is not what he wants. His time and that of the salesman have been wasted. Now, had the real-estate office been a modern one, with an airplane as the salesman's assistant, Mr. Smith could have been greatly assisted in his search. In fact, it is probable that it would have been unnecessary for him to leave the office until his selection had been narrowed down to one or two available selections.

Harrington Emerson, one of the shrewdest industrial counselors and efficiency engineers in the world, has repeatedly stated that visualization is the greatest salesman in the world. Real-estate dealers are commencing to realize the truth of this statement, and in aerial photographs are finding the means to commercialize the fact. With a series of air photographs showing the properties for sale, the customer is able to visualize for himself the land he is thinking of purchasing. The view can be made more attractive if desired, by tinting the prints in their natural colors, and the mental exhilaration thus caused by sight of the home and the surrounding terrain in all their natural beauty reacts to the advantage of the real-estate dealer.

Nor does the use of air photographs end there. Real-estate dealers are finding it to their interest to have an annual photographic map made of their city, thus showing graphically its growth from year to year. Such a map would be of great value in bringing to the attention of prospective customers residing at a distance, the railroad, harbor, and docking facilities, and engineering projects under way or already in existence, such as large public buildings, canals, and traction lines. The cost of an annual map would be small compared to the returns.

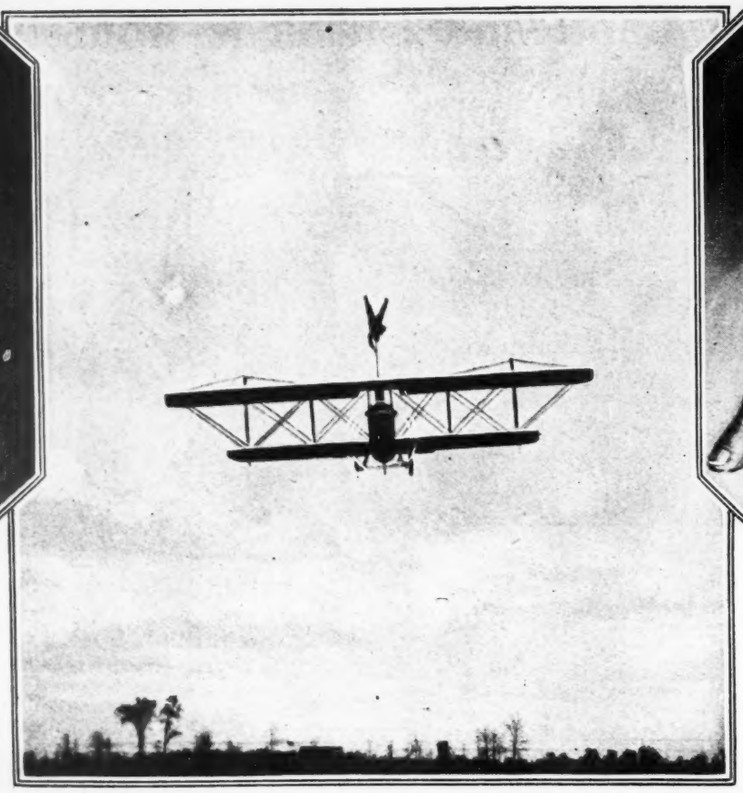


The air photograph is finding a wide use by trade associations in advertising their commercial and housing facilities. The view on the left shows a water-and-rail terminal; the one on the right an extensive community settlement, as seen from an airplane

Tintography Is a Decorative Art

ABOVE is shown an example of tintography, which is the new art of diffusive painting. One can gain a good understanding of it by calling to mind the manner in which ink spreads through a piece of blotting-paper when it is allowed to come in contact with it.

When various colored dyes are used with blotting-paper and symmetrically applied, beautiful designs are made. The solutions of the dyes are applied to the blotting-paper through small glass tubes as shown above.



Most Daring Airplane Stunt on Record

MAKING a head stand on top of a six-foot pole mounted on an airplane is one of the most daring stunts in the repertoire of George Plummer, aeronautical engineer and all-around daredevil. He is shown in the picture above doing this aero-acrobatic stunt over his home town, Grover Hill, Ohio.

In spite of the terrific wind that is created by an airplane in flight, Mr. Plummer is able to maintain his balance.

Finger-Cuffs the Style for Criminals

THE finger-cuff has been invented to take the place of the handcuff. It is the invention of Abraham Cushing, a member of the police department of Concord, New Hampshire.

Mr. Cushing believes that the finger-cuff is more effective than the handcuff, and we are inclined to believe him. With one attached, a prisoner could endure very little pulling on one of his fingers, while a handcuffed prisoner can pull with all his strength and not injure his arm to any great extent.

New Automatic Mine-Ventilating Door

IN coal-mines trap-doors are a necessity. They direct air currents and prevent the spread of noxious gases.

The automatic door in the illustration is opened by the coal-car, which presses down the iron strip shown on the inside of the rails at either side of the door. The door stays open as long as any weight is on this bar, but as soon as the car has passed, it is closed by gravity.

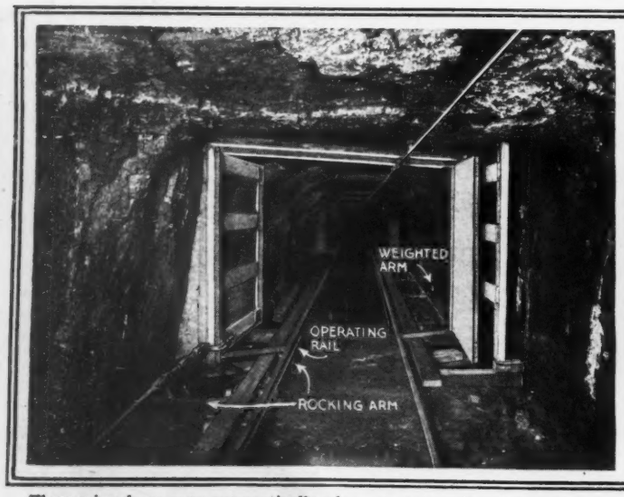
The automatic feature will work irrespective of the speed at which the cars are operated through the doors.

Rider Is Chauffeur and Engine Too

DR. PEASE of Plymouth, England, visits his patients in a man-power automobile, which he pedals like a bicycle. An ancient motor-car was deprived of its engine and a foot drive substituted by bolting the frame of an equally old bicycle between the seat and dashboard.

The pistol on top of the frame is not intended for protection against highwaymen, but is simply a radiator ornament such as every automobilist feels he must carry nowadays.

The strange car was built as a protest against the tax on motors.



These mine-doors open automatically when cars approach and close after

The inventor drives his makeshift automobile by bicycle pedals

Why Do We Do These Stupid Things?

Why do we groan about "Blue Monday"?

WHEN psychological tests show that, far from being the worst day in the week for work, Monday is almost the best?

Tuesday is the week's high point of efficiency as we get down to work after the slight lassitude of Monday. This maximum efficiency lasts until Wednesday afternoon. Fatigue begins to show on Thursday, when production averages 15 per cent below Tuesday's maximum. Friday is the blue day. On Saturday we all are tired, but actually do more work under the stimulating excitement of the approaching week-end and the desire to clean up our work.

Why do we bake all the moisture out of the air in our home during the winter?

WHEN we know that this is one of the chief causes of colds, catarrh and a common cause of nervousness and anemia?

The air in the average home should absorb ten gallons of moisture every twenty-four hours in cold, dry weather. Only by keeping pans of water on your radiators can you be sure the air is healthfully moist. In the average steam-heated apartment the temperature is kept at 72 degrees and the humidity is allowed to fall to 30 per cent. We should be freer from pneumonia, bronchitis, and other ills, have fresher complexions, and incidentally save 12 to 25 per cent. of our coal, if we kept the temperature at about 68 degrees and the humidity at 60 per cent.

Why do we eat starchy foods fried in fat?

WHEN we know that the fat surrounds the starch grains and prevents the digestive fluids from reaching them? Starches are carbohydrates. Their digestion is started by digestive juices in the mouth. Fats are not digested until they reach the intestines. Hence the layer of fat which surrounds the starch particles in fried foods is not broken down until it is too late to digest the starch.

Butter and olive oil are fats which are emulsified in the stomach, and foods fried in them are not considered indigestible.

Why do we postpone the semi-annual visit to the dentist until a tooth starts to ache?

WHEN we know that more diseases are caused by neglected teeth than by alcohol? A cavity in a tooth can harbor 2,000,000,000 germs of 60 species, waiting the opportunity afforded by a run-down condition to start some serious sickness.

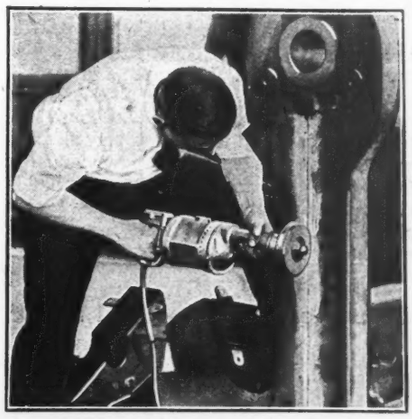
Perfect care of the teeth throughout the year increased the average efficiency of a class of 40 children 99.8 per cent—if they had been men, their earning power would have been nearly doubled.

Phone for Firemen Simplifies Fire Fighting

AT large fires there is much unnecessary confusion. This is brought about by the difficulty the firemen have with communication. They must rely mainly upon shouting.

The telephone has been brought into use at fires during the past few months. The chief is now able to talk quietly and more effectively than ever before. A telephone line is attached to each one of the hoses used and the chief carries on his conversation over these wires. The firemen have a telephone receiver in their helmets and the messages of direction come to them clearly through this medium.

Fires may be fought more successfully if each fireman is provided with a phone

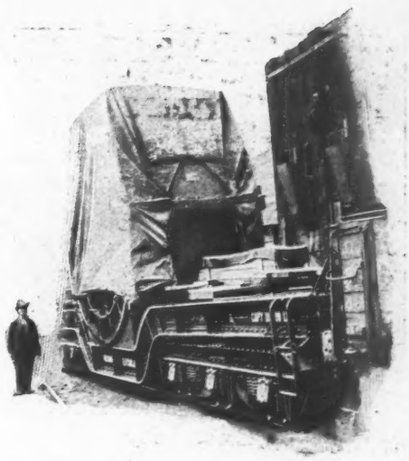


A patented pistol grip enables the workman to exercise perfect control over this portable grinder

Grinder Uses Any Current

THE use of an aluminum alloy housing and a patented pistol grip and trigger switch makes this portable grinder easy to handle and gives the operator perfect control. While it is essentially a portable machine designed to operate on either direct or alternating current, an attachment sent with the machine enables it to be converted into a bench-grinder in thirty seconds. This one machine will handle every grinding, cleaning, buffing, or polishing job around the garage or shop.

ENOUGH seeds of the tree which yields chaulmoogra oil, used for treating leprosy, have now been sent to the United States to establish a promising plantation.



Its huge size made a special low-slung car necessary to transport this generator

Mammoth Generator Requires Special Railway-Car

A SPECIAL freight-car had to be constructed to ship a 35,000-kilowatt turbo generator from the Westinghouse plant in East Pittsburgh to its destination in New York. The stator of this dynamo had to be shipped as a unit, and its weight of fifty tons was far too great for the ordinary railroad flatcar.

Even after a special car had been built, the difficulties of shipment were only begun. The stator was sixteen feet high, and the car had to be routed to New York over railroads having no tunnels.

The lighters that carried it across the bay had to be specially reenforced, and when it was installed in its housing, the workmen found that no available crane could handle the weight, and were forced to jack up this huge piece of machinery for twenty feet.

Gunstock Absorbs Recoil

© Kadel & Herbert

Seventy per cent of the "kick" is absorbed by the springs in this gunstock

IF you say a thing "kicks like a double-barreled shotgun," it is no longer an effective comparison. This innovation in extending gunstocks is equipped with springs that absorb about 70 per cent of the recoil of the exploding shell.

By manipulating the screws shown in the illustration the shot can be given any length of variety of "drop" the shooter prefers. The anti-recoil springs are effective even when the stock is closed.

Marks 3600 Tags an Hour by Electricity

MARKING tags to be placed on goods on the shelves is a very easy operation with a new electrically-driven tag-marker which can be set to mark 2400, 3000, or 3600 tags an hour to suit the operator. The tags are fed into the machine by hand and, by means of an endless chain of trays, carried beneath a miniature type-chase which, by downward movements, alternately comes into contact with the cards and an inking pad.

The type-chase provides for seven lines of marking and has interchangeable slides which print fifteen small or seven large characters to the line. Uniform registering is assured and the markings can be made to line up with characters on the tag such as "Lot," "Size," or "Color." The machine is compact, portable, and weighs only forty-five pounds; in operation it makes little more noise than a typewriter

Ties Bags with Wire Loop

BY placing a wire loop around the neck of paper or cloth bags and twisting the wire tightly with special tools supplied for that purpose, manufacturers of products

The wire loop is placed around the neck of the bag and twisted tight by a small hand tool

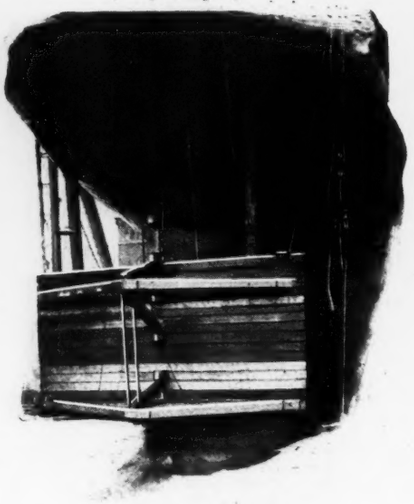
that are shipped in such containers are saved a large amount of money in wasted and damaged goods.

As any one who has tried it will know, it is quite a trick to tie the neck of a flour-sack so that the contents will not leak out. But the wire loop makes it possible for any one to do this. Once sealed, the loop may be as easily untwisted without damaging the bag or its contents.

THE submarine status today of the larger nations is as follows: France 49 built and 5 building; Great Britain, 92 built and 8 building; Italy, 51 built; Japan, 24 built and 15 building; Russia, 36 built and 23 building; the United States, 107 built and 41 building.

Wooden Brake Holds Back Ships When Launched

THE first problem of a shipbuilder at the launching of a vessel is to get the ship into the water. The next is to stop it within a reasonable distance, especially if



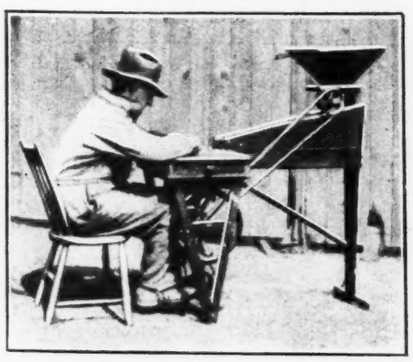
As soon as the launched ship is entirely in the water this brake retards its momentum and brings it to a stop

the waterway is restricted. An effective device, seldom used, consists of a brake-shield made up of wooden boards joined together and braced, as shown in the illustration.

This brake-shield does not commence to function until the water has already begun to retard the movement of the vessel, thus the shock of stoppage is not so great nor so dangerous as when other drags are used.

When the *Mauretania*, with her length of nearly eight hundred feet, was launched, huge chains weighing one thousand tons were used to prevent her from traveling too far out into midstream, but this method is too dangerous for general use. The brake-shield accomplishes the same result without the possibility of harm.

Machine Separates Good Beans from Bad



HOWARD FOGELSANGE, of Clarence, New York, is here shown operating his invention for sorting beans. The beans are placed in the hopper and fall on to two moving belts actuated by a foot-treadle. The inclined belt runs backward, toward the hopper, and flat and imperfect beans will not roll down it on to the horizontal belt in front of the sorter.

Sun Eclipse Is Measured by Photograph and Micrometer

ASTRONOMERS have determined the diameter of the sun and the planets by mathematical calculations, and when an eclipse gives an opportunity to check these calculations by means of actual measurements every precaution is taken to have these as exact as possible. At the Greenwich Observatory, near London, this important work is in charge of Miss Crommelin, the daughter of the astronomer.

Accurate photographs of the eclipse are taken at every stage, and Miss Crommelin measures the negatives with the specially-designed micrometer shown in the picture. Thousands of measurements are taken after every eclipse, and in the case of an important one like that of last April, the entries in the measurements book fill hundreds of pages.

Call-Bell Notifies Dealer when Motorist Wants Gas

A GARAGE at East Troy, Wisconsin, has installed an electric call-bell upon both of its gasoline fountains on the curb in front of its door. This has been found to be of great convenience, both to cus-

A push button on the gasoline fountain calls the proprietor when a customer drives up

tomers and to the firm and its employees

The owner is no longer obliged to keep watch for fear some motorist may grow impatient of waiting and go elsewhere for gasoline. As soon as the bell rings in the shop, some one hurries to the curb. There is very little delay and the simple device has brought much trade from car-owners who appreciate the service.

Science is a first-rate piece of furniture for a man's upper chamber if he has common sense on the ground floor.—*Oliver Wendell Holmes.*

Two-Man Plowing in Persia

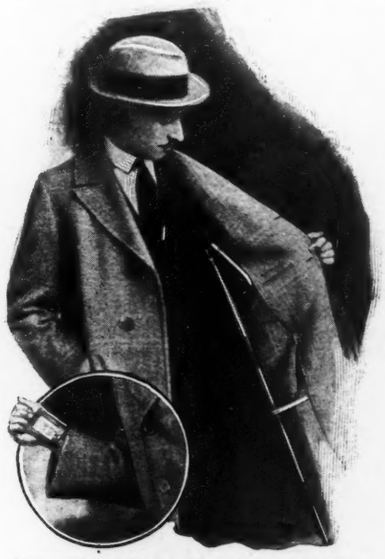
A PERSIAN plow looks like a rake that has teeth projecting from both sides of the backbone. Two men are needed to operate one. One of them pushes on the wooden handle to which the "plow" is fastened; the other man pulls on a rope attached to the end teeth.

The men work the plow back and forth in the ground until the dirt is thoroughly stirred up.

A Multi-Pocket Overcoat

MODISH and innocent-looking as is this overcoat, it has as many tricks as a prestidigitator. It was invented by a London tailor, who got tired of unbuttoning his coat in inclement weather whenever he wanted something in an inside pocket.

The greatest feature is the attachment for an umbrella. Instead of carrying it in the hand, it is slipped through a couple of loops inside the coat. A special pipe pocket, a pad and pencil-holder, a safety pocket for money, and a ticket-holder in the sleeve are other conveniences of the garment.



Commuting-ticket-holder and umbrella-clasps are only two of the features of this overcoat

Movie Films Developed by Automatic Machine

A DEVELOPING machine for the "positive" copies of moving-picture films has been invented by George K. Spoor, which will develop, wash, and dry a thousand feet of film in ten minutes, reduce cutting and splicing to the minimum, and save 70 per cent of the labor charges in the movie dark-room.

This machine runs the entire thousand feet of film through developer, hypo, washer, and dryer in one operation. The process is continuous. The film is led over a series of rollers that pass it back and forth from top to bottom of a tank seven feet deep. The speed of the film is regulated so that it passes through the tank in the exact time required for perfect development.

The pictures are hypoed and washed in five changes of water in the same manner, and then pass between chamois-covered drying-wheels that squeeze off all surplus water before the film enters the dryer.

As the film passes over the wheels, it is dried by a current of hot air and polished between felt-covered wheels. As the last of the film is entering the developer, the first lengths are being wound for shipment.

Electrical Power Today

TO-DAY in the United States there are 275,891 manufacturing plants that rely wholly upon electricity for power. Thirty years ago there was scarcely one.

Banyan-Tree Spreads 800 Feet

IN the eighteenth century the seed of the banyan-tree shown above started its growth, and it has never stopped. To-day its one great trunk, over forty-two feet in girth, is the main support of numberless other aerial roots that have grown into the ground from hanging branches.

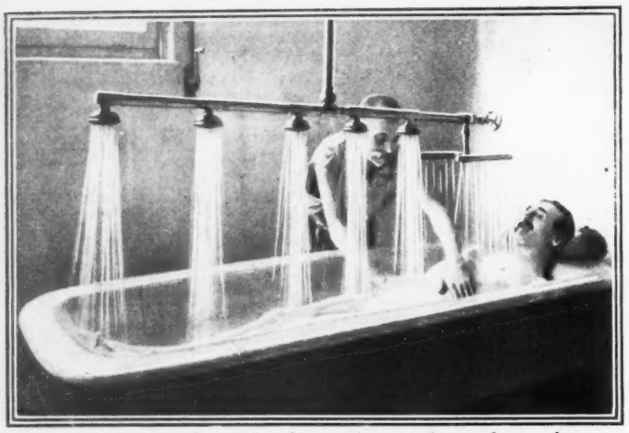
This monster tree with its tentlike top is one of the exhibits of the Royal Botanical Gardens of Calcutta, India.

Records Traffic Vibrations

THIS instrument demonstrates that two skyscrapers will lean toward each other when a loaded truck passes in the street between them. Only a minute fraction of an inch, of course, but enough for this machine to measure.

It is designed to record the vibrations caused by modern city traffic. By means of a pencil attached to various wires connected with the different parts of a building, the effects of the shocks and jolts in the street are recorded. Steam tractors, heavy vehicles drawn by horses, and motor-buses are responsible for the principal jars that actually shake a tall building.

The maze of wires connected with this instrument record vibrations from traffic

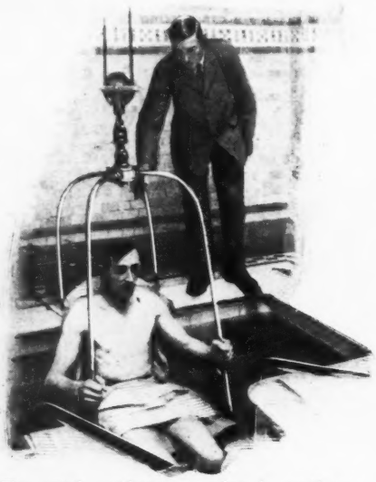


A combination of curative hot springs and muscle manipulation is one of the methods employed to heal bodily ills

Hot Baths 2784 Years Old

ABOUT a hundred miles southwest of London, England, are the famous hot springs of Bath. Hot springs in themselves are not new nor unusual, but these are interesting because of their early history.

Many hundred years before Christ, a British king discovered the springs and their healing power. The waters were believed to be particularly useful in the curing of leprosy.

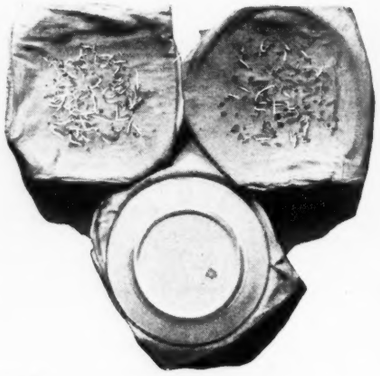


For weak patients a swing is used to lower them into the baths

Later, when the Romans took over the country, they built wonderful structures over the springs. At the present time the baths are equipped with all the latest mechano-therapy devices and any number of special applications of the hot Bath waters. Two of these applications are shown in the illustrations.

A Simple Seed-Tester Made of Two Dinner-Plates

TWO dinner-plates lined with cloth or blotting-paper make the homemade seed-tester suggested by the Department of Agriculture for testing clover, alfalfa, and cereal seeds at home. The units comprising the simple outfit are clearly shown in the illustration.



Two dinner-plates and a piece of damp cloth or blotting-paper can be used as a practical seed-tester

One plate is placed face up and over it is laid a sheet of blotting-paper or a piece of heavy cloth that has been soaked in water. The seeds are placed on the covering and then protected from the outside elements by a second plate. If desired, clean sand may be substituted for the cloth or paper.

The percentage of seeds that eventually sprout is the evidence upon which the farmer may select the seed for his next year's crop.

Moisture, warmth, and fresh air are the requisites for seed-sprouting. Moisture should be present at all times, but the seeds should not lie in the water. The usual living-room temperature of from 65 to 70 degrees Fahrenheit is suitable for germination. Fresh air must be permitted access to the tester for the sake of the oxygen in it.

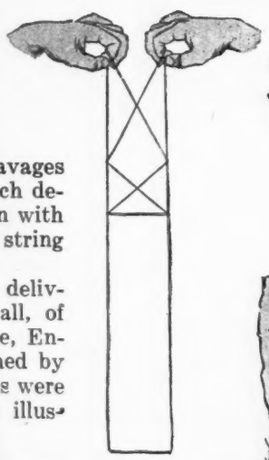
Besides watching the number of seeds that sprout, it is advisable to note the rapidity of sprouting. Slow germination is a sign of low vitality.

For those farmers who do not have the facilities for testing seeds, the Department of Agriculture maintains an extensive laboratory at Washington where tests will be carried out on any seed samples submitted. The tests at the laboratory are, of course, much more thorough than would be possible on the farm. To make a complete analysis, the seed experts weigh the seeds on sensitive balances to compare them with normal seed, and in many cases also study the seeds under a microscope.

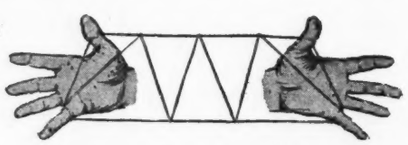
An Evening's Entertainment with a Piece of String

CAT'S cradle is played by babies all around the world, from London to Korea, and among civilized peoples it is the last vestige of a pastime universally popular among savages—the string games, in which designs and figures are woven with the fingers in a loop of string about seven feet long.

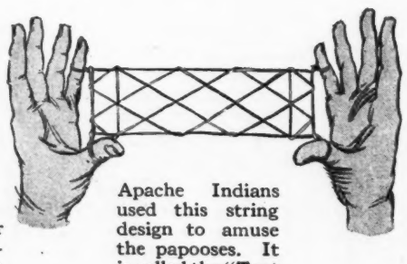
According to a lecture delivered by W. W. Rouse Ball, of Trinity College, Cambridge, England, in a booklet published by Heffer & Sons, these figures were originated by savages to illustrate stories told to their children and as an indoor amusement. They form an important branch of folk-lore of which nothing was known up to a few years ago.



By drawing on the upper ends the motion is similar to that of a man climbing a tree



The "Batoka Gorge" is a design peculiar to the natives of Central Africa



Apache Indians used this string design to amuse the papooses. It is called the "Tent Flap"

Sometimes the figures illustrate a place, such as the Batoka Gorge on the Zambesi River in Africa; sometimes an article in daily use, like the tent-flap figure made by the Apache Indians; sometimes the figures will move, like that depicting a man climbing a tree.

Anthropologists study these apparently trivial matters because they are valuable to explorers traveling among primitive peoples. Although simple to the savage, civilized people often find these figures difficult to make.

What Do You Want to Know ?

Let Popular Science Monthly Answer Your Problems in General Science

An Information Service for Readers Who Want the Facts

Are black clothes actually warmer than white clothes?—G. B.

Yes. A perfectly black surface tends to absorb all of the visible and part of the invisible radiations. A white surface, on the other hand, reflects all of the visible and part of the invisible radiations, including the infra-red or heat waves. Try this simple experiment to convince yourself of this fact. Lay a piece of white cloth and a piece of black cloth on the surface of the snow while the sun is shining. The snow under the black cloth will melt, but the snow under the white piece will remain frozen.

Why must an electric-light filament be burned in a vacuum?—A. O T.

When a metal is heated in the presence of oxygen, the oxygen will combine chemically with the metal and an oxide will be formed. The metal filament has such a small cross-section that the least trace of oxygen will rapidly consume it. Therefore it is necessary to suck every possible bit of air from the bulb. Nitrogen and other chemically inert gases are often introduced into electric-light bulbs.

Where is the deepest part of the Atlantic Ocean?—F. A. L.

The *Titanic* sank within a few miles of the deepest part of the Atlantic Ocean. A depth of approximately six miles has been recorded at that point. No greater depth has ever been measured.

A friend told me that it is dangerous to stand in the bathtub and turn on the electric light. Is this so?—S. O'T.

Your friend was right. It is best to be cautious. The electric-light system of a residence is usually "grounded" and it is possible to put oneself directly across the line if the light is turned on while the bare feet are in contact with the metal bathtub.

What makes the electric lights in my house flicker?—B. I. M.

Your power company is probably using a low-cycle current. With a twenty-five cycle current there are fifty alternations a second. This means that the current passing through your lights falls to zero value fifty times a second. The heated filament responds to these fluctuations. The same thing happens with sixty-cycle current, but the changes take place too rapidly to affect the eye. There is no remedy.

What is the highest temperature that has been reached?—M. T. C.

Nine thousand degrees Fahrenheit. This was obtained by the explosion of cordite in a steel cylinder. The temperature was only of a moment's duration.

What causes air pockets?—E. W.

Air pockets have long been a menace to aviators. Those who are familiar with water eddies and whirlpools, can readily visualize air pockets, since they are formed in much the same way. Air pockets are caused by local refraction of the atmosphere. Cyclones are really air pockets on an enormous scale. Small air pockets vary in diameter from a few feet to several hundred feet. Airplanes driving into an air pocket are sucked downward and the aviators lose all control. Unlike the cyclone, small air pockets are absolutely invisible.

Why does burning wood snap?—E. L. G.

Perfectly dry wood will not snap or crackle when it is burning. However, green wood has a large moisture content and when the exterior of this wood is heated to the burning point, the moisture in the interior is volatilized and an interior pressure is created. Continued heating will cause the expansion of the vapor to the point where the fiber of the wood will be ruptured, causing a sharp report.

Learn here the answers to many interesting questions asked by readers of Popular Science Monthly.

And ask questions of your own.

Every reasonable specific query in the field of general science addressed to this department will receive a prompt reply.

Readers who understand this service will appreciate, of course, that we cannot accept questions involving extensive research, answers too lengthy for the space of a letter, and sets of questions that can best be handled by individual study of available reference books. Legal and medical queries cannot be answered.

A stamped self-addressed envelope must accompany each question.

Address the Editor, Popular Science Monthly, 225 West 39th Street, New York.

How is condensed milk made?—W. P. I.

Milk has a large percentage of water. In the manufacture of condensed milk, most of the water is evaporated in vacuum pans. A large portion of sugar is added to the resulting product and this acts as a preservative. The resulting thin syrupy liquid is placed in hermetically sealed cans.

What makes the leaves of some trees turn red in autumn?—B. I. W.

In the summer the leaves of plants acquire their green color because of the peculiar chemical substance called chlorophyll that is formed within their cells. Chlorophyll has the property of absorbing the red rays from the sun and of reflecting the blue and yellow rays that combine to produce green. In the autumn the chlorophyll decays from lack of nourishment and the leaves assume a brown or reddish color.

What is the best hard coal to use in a small vapor-heat furnace?—R. F. A.

It would be wise to consult your local dealer, but many experts recommend a mixture of nut and stove coal that banks well and holds the fire economically.

What is laughing gas made of? Is it injurious to take?—M. C.

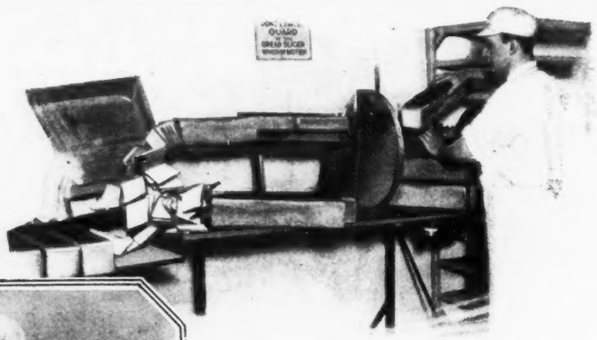
This gas is made by heating solid ammonium nitrate in a flask. The reaction produces water and nitrous oxide. It is the safest anesthetic known to medical science, but occasional fatalities have resulted from its use. It takes its name from the laughing symptoms that sometimes follow its inhalation in small quantities.

I have noticed that the compression space in marine motors is larger than in automobile motors. What is the reason for this?—A. M. O.

Marine engines operate at full load most of the time, while automobile engines are subjected to full throttle only for comparatively short periods. When an engine is continually operating at full load, there is a greater tendency to pre-ignite unless the compression space is made larger, which is the reason for the larger construction in marine motors.

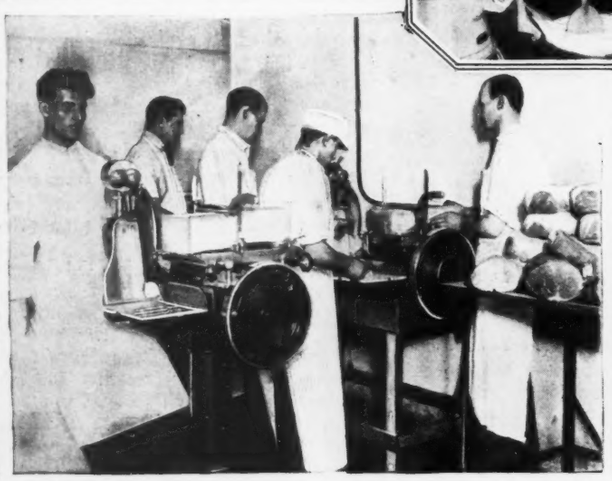
Special Machines Turn out Millions of Sandwiches for Noontime Lunches

One firm alone prepares twenty million annually



An automatic slicer works day and night to cut the bread for the hungry hordes of sandwich-eaters. Over a million are consumed each noon in the city of New York alone

At the right an expert is mixing pimento cheese in a special machine for a batch of many thousand sandwiches. The soda-fountain lunch has caused this increase in the demand for these concentrated meals



Carloads of ham and cheese are sliced daily by these machines. Other machines wrap each sandwich in wax paper and then stick on the label

The chicken sandwich is a favorite with all of us, and hundreds of fowls must be roasted and sliced to fill the noon-day call for this delicacy

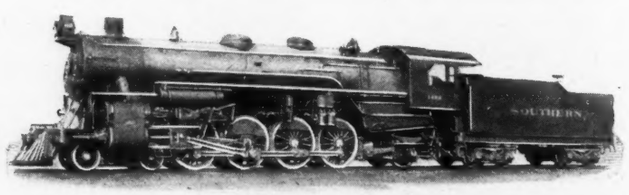
The First and Last Word in Steam-Locomotives

NINETY years ago the first locomotive actually built in the United States for railroad service made its maiden trip on the Charleston and Hamburg Railroad. It worked well on the outward journey, but on the way back the weight proved too much for the wheels, which collapsed and ditched the train. But this trouble was soon remedied and the "Best Friend of Charleston," as the locomotive was nicknamed, was soon steaming off its sixteen miles an hour as regularly as requirements demanded of it. Unloaded, it was able to "speed up" to thirty-five miles an hour, although the contract called for only ten miles an hour.

This wonderful locomotive had a vertical boiler similar to those used on hoisting equipments of to-day. The four wheels had iron hubs and tires, but wooden spokes and felloes. The two cylinders, six inches in diameter, had a stroke of sixteen inches and were placed in front of the boiler, from whence they worked the cranks inside the frame.

As an indication of the growth of railroads in the last ninety years, it is interesting to compare this chugging pioneer with the latest locomotive built by the same railroad with its length of eighty-six feet, its weight of two hundred and sixty tons, and its possible speed of a mile a minute.

The first locomotive had iron rims, wooden spokes, and a speed, when loaded, of sixteen miles an hour

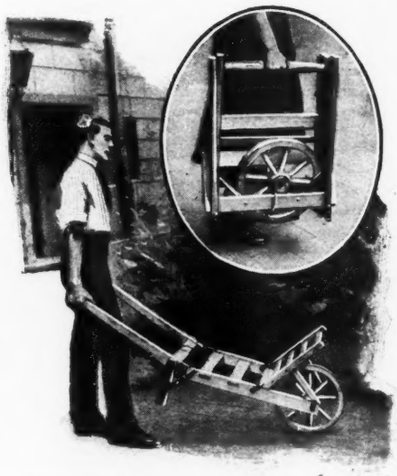


But the latest engine on the same line pulls a heavy train at more than a mile a minute

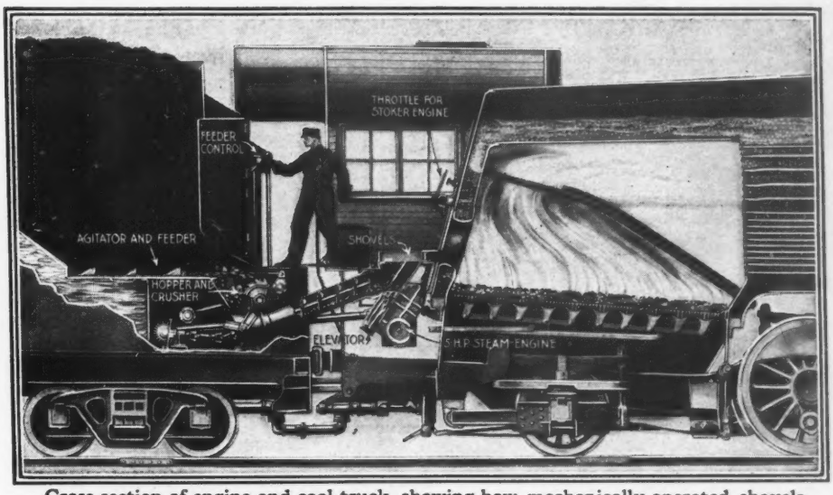
This Wheelbarrow Folds Up for Carrying

WHEELBARROWS are bulky things to transport. One takes up more space than it is entitled to, considering its weight and construction. It is a wonder that no one has thought previously of making the wheelbarrow so that it can be folded into a compact bundle.

When fully collapsed, the wheel fits into the lower part of the framework and the axle serves as a handle for the outfit. When it is opened and set up the folding parts are held rigid by stout metal hinges.



This wheelbarrow folds up and saves space in shipping and storage



Cross-section of engine and coal-truck, showing how mechanically operated shovels do away with a fireman's services, keeping the fire up to the pitch desired

Mechanical Stoker Produces Cleaner Fire

THIS mechanical stoker, perfected for use on locomotives, ran eighteen consecutive trips under test over an eighty-nine-mile division, with the fire-door sealed between terminals. No inspection of the fire was possible en route, yet it was found to be in perfect condition at the end of the run, although the engine was pulling full tonnage.

After the trip there was from three to six inches of fire on the grates. No difficulty was encountered in cleaning the fire at terminals because of the comparative absence of clinker, and it was found perfectly feasible to make round trips without cleaning the fire other than to shake the grates.

The stoker fires the engine by mechanically operated shovels, which pitch in coal just as a fireman would do.

The complete cycle of operations is as follows: a measured quantity of coal is dropped into a screw-conveyor, which delivers it to the elevators feeding the shovels. The amount of coal used is controlled by an agitator, which drops the necessary quantity into the conveyor.

A Water-Air Propeller for Use in Shallow Waters

A COMBINATION propeller, recently patented in France, operating efficiently both in water and air, permits a flat-bottom cargo-boat carrying several tons of merchandise to be navigated on rivers heretofore considered too shallow to serve as inland waterways.

If all the shallow rivers in the United States could be used for transportation, a great saving in freight charges would be effected and the danger of rail congestion removed; but the expense of deepening the waterways has been an insuperable obstacle. Inventors have sought to avoid the cost of digging canals by equipping flat-bottomed boats with airplane propellers. This French invention promises success in this field.

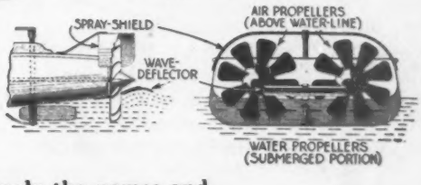
The propeller will operate in less than six inches of water, and from experiments made on small models, its inventor, M. Gambin, claims for it a tractive force comparable to that of the submerged screw-propeller. The driving resistance is obtained partly from the water and partly from the air.

Two wheels are used with blades in the form of a screw, so that the propeller is essentially a screw of large diameter formed of multiple paddles whose axis is parallel to that of the boat. The blades barely touch the water, and even when the boat is under way, the water level is well below the hub of the wheels.

In going ahead, each blade acts as a small double scull. As is usual with twin screws, the wheels turn inward in opposite directions, but since they are high out of the water, a raised wake is formed between them that gives the propeller blades a better grip.

In addition to this powerful sculling action of the blades in the water, the large diameter of the wheels and the form of the blades, which are similar in principle to those of an airplane, produce an action in the air that adds considerably to their propulsive effect. Instead of having air resistance to overcome during the upper portion of their turn, these propellers actually increase their efficiency.

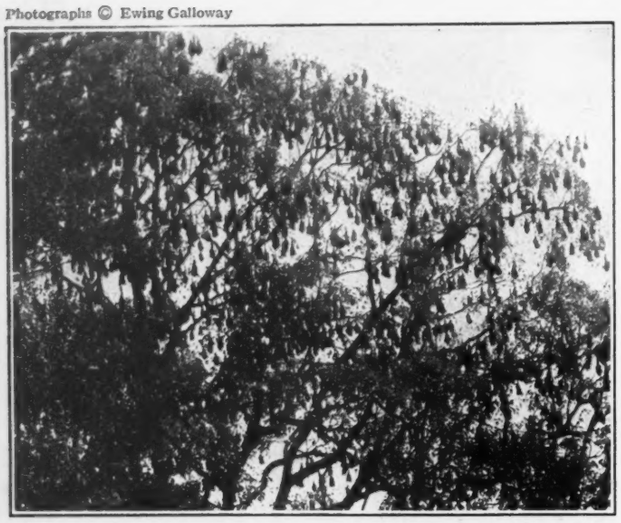
From a practical viewpoint it is most advantageous to have the hub of the propellers above the water level, where they are more accessible for repairs.



These twin screws, shown at the right, for driving vessels in shallow streams, react against both air and water. A wave deflector prevents the stern from being drawn down by the action of the screws

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly

Photographs © Ewing Galloway



These huge bats hanging from every branch, and looking somewhat like the fruit itself, are the fruit-growers' pest in Ceylon

Fruit-Eating Bats of Ceylon

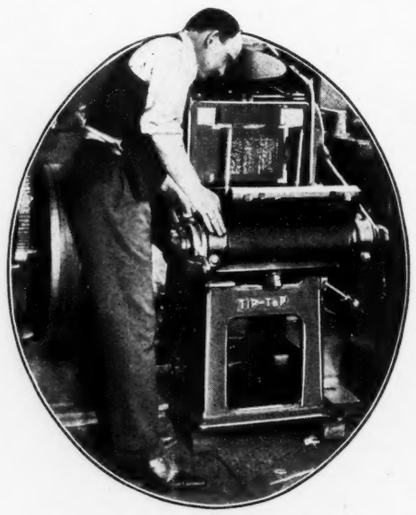
THE objects hanging from the limbs of this tree are neither fruit nor hornets' nests, but flying foxes, or fruit-eating bats. These bats measure more than two feet from wing tip to wing tip and are so numerous that if they were unchecked, they would make it impossible to raise fruit in the neighborhood where they abound.

These bats hang from the trees by their feet, with their heads down. Certain trees are selected as resting-places, and the whole colony hangs there during the day—which makes it easier for the bat-killers.

The official bat-killer of Kandy exhibits a specimen with a wing-spread of twenty-four inches

Printing-Press Is a War Veteran

UNTIL now, Gutenberg's first press was the only one we remembered, but "Tip-Top Kelly" is a printing-press with a history and a service record. It first went into action in the German trenches, where it unsuccessfully preached the doctrine of "*Deutschland über alles.*" It was then shipped to Ireland as part of the equipment of the ill-fated expedition of Sir Roger Casement, and although Casement failed to incite revolution in Ireland, the press was landed and set up in a secret plant in Cullicurry, County Galway, Ireland, where it was operated by the Sinn Fein. It recently came to the United States and now works for a prosaic commercial printer, but its secret history has leaked out and, as a result, scores of those who favor the Wearing of the Green have made a pilgrimage to the inky shrine.



This press has been in a war, a revolution, and a wreck, yet it still operates effectively

It is not only a very interesting relic of the war, but the only press of its kind in the United States, and a tribute to German inventive genius. It operates noiselessly; and incorporates a die-cutter, an automatic sheet-adjuster, an embosser, creaser, perforator, and color-printer, with automatic guides, and it boasts a producing capacity of four thousand sheets an hour.

To demonstrate what delicate fabrics a washing-machine would handle, a hardware merchant washed some dollar bills in the machine, putting them through the wringer afterward, and drying them with an electric fan.

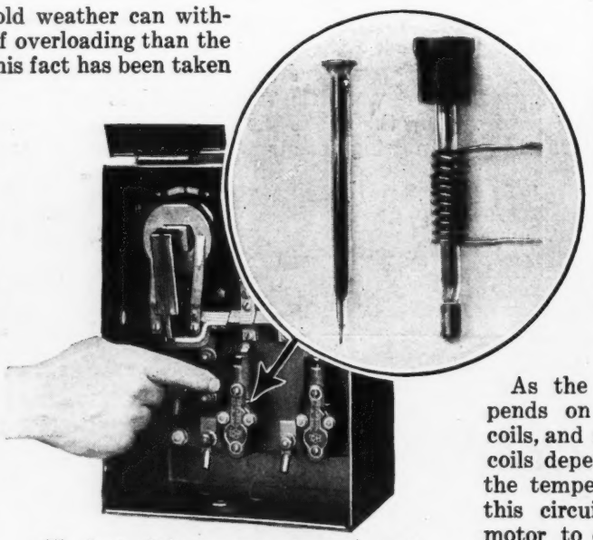
Mercury Column Protects the Electric Motor

AN electric motor operating in cold weather can withstand a much greater amount of overloading than the same motor on hot summer days. This fact has been taken into consideration in the manufacture of a new protective device for electric motors.

The new overload relay consists of a glass tube containing a column of mercury. Coiled around the tube are several turns of heavy wire. The latter is part of the same wire that goes to the motor from the lines, while the mercury is part of the same circuit that goes to the relay magnet and the contactors.

When fuses are used for this purpose, the sudden rush of current when the motor is thrown on the line, blows them instantly, causing unnecessary delay and waste. With this new relay such trouble is done away with.

If the motor is overloaded, the excessive current flowing in the coils surrounding the mercury produces an unusual heat, causing the mercury to boil. As it boils and vaporizes, the circuit is broken and the magnet allows the contact fingers to drop away.

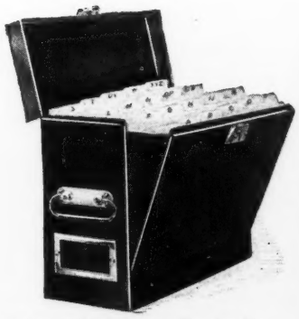


The heat of the current acts on the mercury column (see oval) and in this manner controls the motor load

Once the interruption has occurred, the mercury—now no longer heated—cools and reforms the column, thus making the circuit again, permitting the motor to be started, and repeating its warning when necessary.

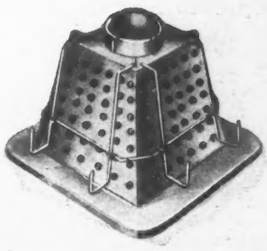
As the action of the mercury depends on the heat given off by the coils, and as the heat given off by the coils depends among other things on the temperature of the air around it, this circuit-breaker will permit the motor to carry a larger load on cold days. At the same time it affords adequate protection in all weather.

Picture News of Recent Developments in Home and Office Devices

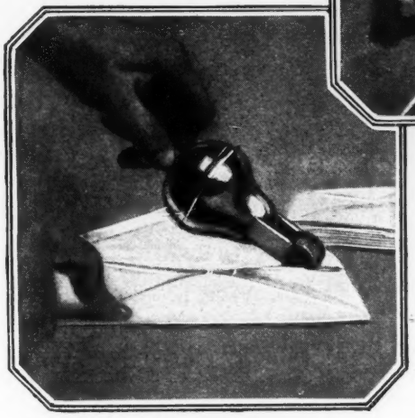


This locked steel file is intended to make the private papers kept at home as convenient for reference and safe against loss as those in the office files

Stenographers can keep abreast of the multigraph by using an attachment which ejects the envelope already addressed and inserts a new one exactly in position, ready to be typed. All this is accomplished by a single pull on the lever at the right



Four slices of toast and four boiled eggs are cooked simultaneously over one burner by this invention. In addition to the time saved, the steam from the boiling water keeps the toast crisp and soft and the toast automatically times the boiling of the eggs

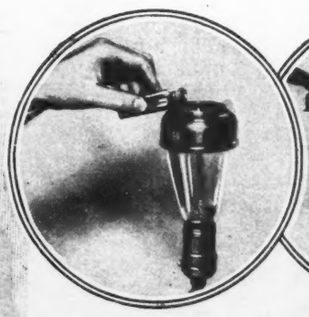


When this stamp-moistener is left on the desk, the shape of the base raises the tip into the air. It cannot leak and spoil office furniture

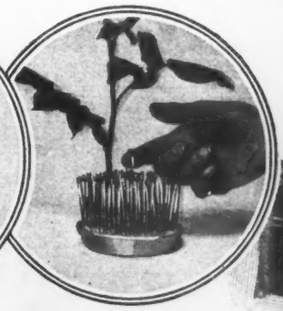
A stiff petticoat of cloth penwipers slipped over the draftsman's ink-bottle keeps the ruling-pens clean and prevents the ink from being overturned

The time a highly paid mechanic spends in looking for the pencil he has dropped is worth more than the pencil. This attachment keeps it from rolling out of sight

This motor-driven outfit takes the place of muscle in the kitchen. It mixes the bread, whips the cream, makes the ice-cream, cleans and sharpens the knives



A few drops of perfume poured into the hollow top of this shade-holder scents the room like a rose-garden as soon as the bulb is lighted



Flowers can be arranged at any angle in this wire holder, which is heavy enough to support two dozen American Beauty roses without tipping

Market baskets mounted on wheels for ease in traveling permit housewives to buy groceries at lower cost by eliminating the expenses of delivery

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly

Science does not know its debt to imagination.—*Ralph Waldo Emerson.*

Wire Mesh Used for Concrete Forms

TIMBER is so much more expensive than concrete in Germany that even temporary houses are being built of the latter material. But the molds which form the walls and floors have to be made of wire mesh and gravel because of the cost of wood for this purpose. The wire frames are filled with gravel and then covered with cement or stucco which joins with the gravel to form a solid crust.

Where wood is scarce wire mesh and gravel are being used for concrete forms

Stacker Piles Wood for News Paper

THESE twin mountains of wooden blocks will be made into newsprint for many of the editions of 1922. Such great piles are possible only by the use of the traveling belt stacker illustrated, which is moved along a temporary track after the piles have reached the height of forty feet. From the sawmills the blocks slide down the inclined chute shown in the foreground and drop on the traveling belt of the stacker, which delivers them in rotation to the top of the pile.

There is no waste in modern lumbering methods. Nowadays the mill saws the large spruce logs into lumber, and small ones into wood pulp blocks.

Film Rewinds Itself in New Magazine

A NEW magazine for motion-picture projectors in which the film commences to unwind from the center instead of the outside has been invented. The film is not wound in the ordinary round form, but is pulled from point to point inside the ten metal fingers in the shape of a decagon.

Rewinding of movie film is eliminated by taking the film from the reel center

An automatic governor keeps the strip at a slight tension from the start to the finish of each reel.

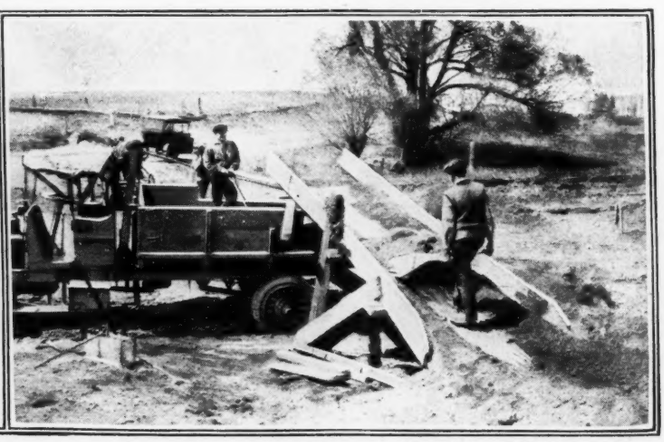
Paint Line on Road for Safety's Sake

MOTORISTS who cross the Canejo Pass near Camarillo, California, cannot conceal or deny the fact that they are hogging the road. A twelve-inch black strip has been painted in the center of the road for several miles, and constantly reminds the driver to get over on his own side. The highway at this point is extremely curved and presents numberless opportunities for the careless driver to cause a bad accident, but it has been found that few tourists are so selfish as to hog the road when they realize that they are courting disaster by doing so.

The black line in the center of the road is as effective as a "Keep to the right!" sign

Horse-Driven Scoop Used to Fill Truck

AT Iowa State College they have decided that it is easier to drive a horse than to swing a shovel, so they load gravel with a scoop. A team attached to a wheel scraper strips the gravel and gathers it into piles in front of a chute. When the trucks drive up, a cable is fastened to the scraper and the horse hauls the gravel up the incline into the wagon. Skilful driving is required to see that the horse does not pull the scraper over the edge of the chute, but compared with the ordinary method of loading a truck the saving in energy makes it worth while.



A long cable hitched to the scoop and hauled by a horse makes truck-loading easier and faster

New Catcher's Mask Gives Better Vision

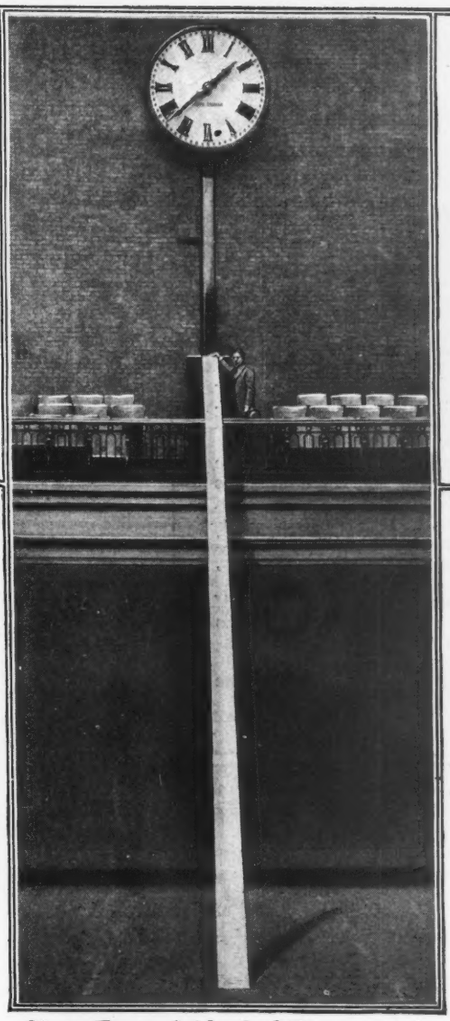
FRANK SNYDER, catcher of the New York Giants, is said to be highly pleased with this new mask, designed to give the backstop better vision and improved protection. The broad bars are made of composition applied over a light steel framework, and their size and slanting angles cause a foul tip to glance off the surface of the mask with far less danger of injury to the player than was the case with the old bar type.

Instead of the familiar forehead and chin straps the new mask is carried on a heavy cushion which reaches completely around the head.

Twin Arc Gives Double Light at Same Current Cost

AN Ohio manufacturer has developed a photographic arc lamp for which he claims double illumination with no increase in the cost of current consumed. The lamp consists of two arcs of high intensity so placed as to produce a better distribution of light by eliminating the harsh shadows that frequently accompany the use of single arcs. With twin arcs it is also easier for the photographer to model the features of the sitter.

An adjustable stand holds the lamp in any position without resorting to thumb screws. The arcs may be extended from near the floor level to nine and one half feet above it.



Sixty Feet of Alcohol Propaganda

THE long white strip, of which only about forty feet shows in the photograph, is a list of medicines in the preparation of which good grain alcohol is a necessity. There are 3600 of them, and written on a typewriter in single space the list is sixty feet long.

In many cases the final product does not contain a trace of anything disagreeable to Volstead, but alcohol is a necessity as a solvent in some stage of the manufacture. The list was prepared to show that the restrictions on the use of alcohol in the arts should be relaxed, and that it is a mistake to regard it only as a beverage.

These Binoculars Steal Photographs

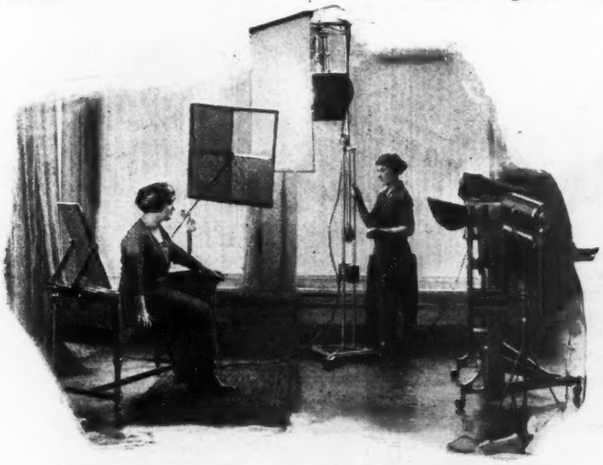
A COMBINATION camera-stereoscope, looking like a pair of field-glasses, is a Frenchman's invention to enable a photographer to snap-shot unsuspecting persons to the right or left of him. The glasses do not "look" ahead. The photographer apparently looks straight ahead, but a prismatic arrangement reflects the view to the right or left of him. As field-glasses the physiograph, its name, is a dummy, but it may be used (with side vision) as a stereoscope. It uses films 4½ by 6 centimeters, and its stereoscopic field is 45 by 107 millimeters. The picture shows the physiograph in use.

Mail-Bags Are Cleaned by Means of Tumbling-Barrel

THE Post Office maintains a special department for the cleaning and renovating of mail-bags. In their rapid journey around the country the bags acquire an incredible amount of dust and grime which must be removed before any repairs are made.

When the bags are received at the cleaning-room they are placed on a huge star made of slats. As the star revolves rapidly the bags are thrown from point to point until all the dirt has been beaten out and removed by a suction system.

This star, known by the workers as the "tumbling-barrel," may be seen at the left of the open door in the illustration.



A counterbalanced stand allows this arc lamp to be adjusted to any height

The cleaning-room where mail bags are freed of dust and dirt

How Fast Does Your Mind Work? Test It!

Puzzles will do for your brain what sports do for your body

A Mental Athletics course, conducted by Sam Loyd, the famous puzzle expert

Twenty-Five Dollars in Prizes

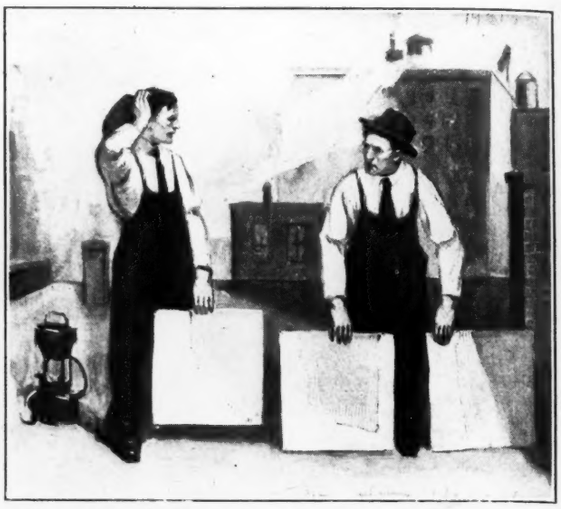
EDUCATORS say that puzzle-solving is the best kind of mind-training—best, because it comes as sport instead of drudgery. As proof of this, consider the fact that Sam Loyd's most faithful puzzle fans have been inventors, engineers, and business men.

A first prize of $10 will be awarded the reader who sends in the best set of correct answers and analyses covering the three problems on this page; a second prize of $5 for the next best set; and ten other prizes of $1 for the ten next best sets.

Answers must be received not later than December 8, addressed to the Puzzle Editor, Popular Science Monthly, 225 West 39th St., New York, N. Y.

By "best" is meant absolute correctness of solution—then, if other points must be considered, clearness of analysis. Mr. Loyd's decision must be considered as final. In case of a tie, each competitor will be awarded the full amount of the prize tied for.

Answers and names of the prize-winners will be published in the March issue.

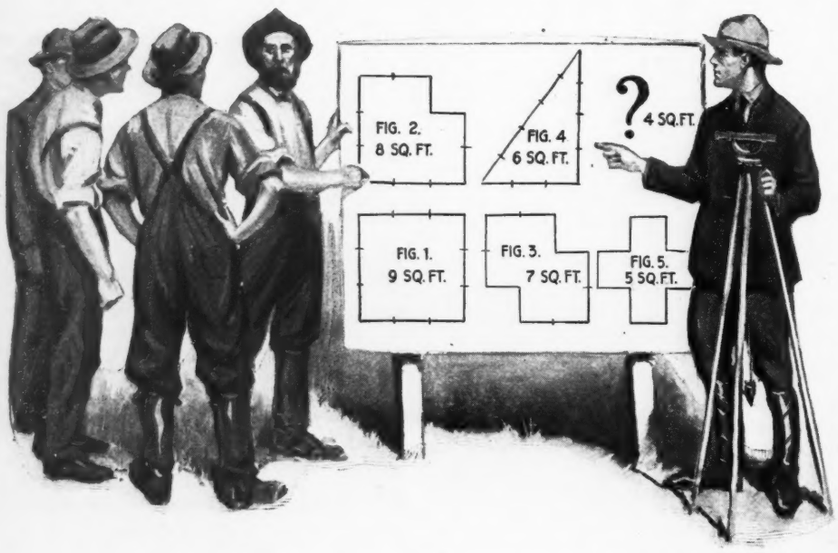


How Would You Patch This Roof if You Were Given the Job?

THE two tinsmiths pictured above have a problem on their hands. The square patch which they are to place on the roof has an area equal to the three square pieces of tin which they brought with them.

Now, four similar squares will combine easily to form one large square, but it is a difficult matter to take three squares and combine them into one large square.

Can you help the tinsmiths? Figure out the fewest number of pieces into which the three pieces of tin may be cut in order to produce a large square equal to the sum of their areas.



Try Your Hand at Surveying and Help These Miners Fence Their Land

A GROUP of miners decided that a pooling of their claims would be advantageous to all concerned. No two of the properties had the same dimensions, but it developed that each man had enclosed his claim with the same amount of fencing.

This fact appeared to the men as a fair reason for equal distribution of stock in the corporation that was formed by the pooling of their interests.

But a surveyor appeared on the scene and pointed out that, contrary to the miners' opinion, the length of fence surrounding each plot gave no indication of the acreage contained in it.

To aid in making this clear to the puzzled miners, the surveyor drew a series of diagrams on a near-by signboard, showing examples of five enclosures, each surrounded by twelve rails of similar length.

To better understand his demonstration, let us call each rail one foot long. Then in the first diagram the area is, of course, nine square feet. In the second the twelve rails enclose eight square feet; in the third, seven square feet; in the fourth, six square feet and in the fifth diagram, five square feet. All this is simple enough.

But then comes the puzzling question which furnishes us with a brain-testing problem: How could his illustration of a gradually shrinking area be carried a step further? In other words, how can the twelve rails be arranged so that the area enclosed by the same amount of fencing will be only *four* square feet?

How Far Did the Car Go?

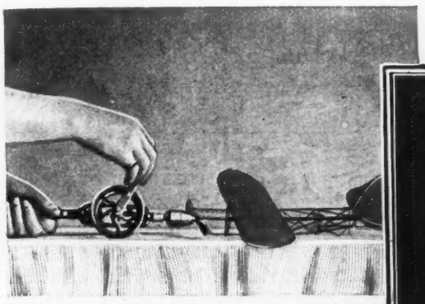
AT a recent automobile race there was considerable discussion among a group of spectators regarding the distance covered by the winning car.

The driver was on the track for exactly one hour. He went one third of the total distance at the rate of sixty miles an hour; he covered the second third at the rate of sixty-five miles an hour; and during the last third he maintained a speed of seventy miles an hour.

This much was agreed upon by the observers. But when it came to computing the distance covered they could not agree. Can you figure it out?

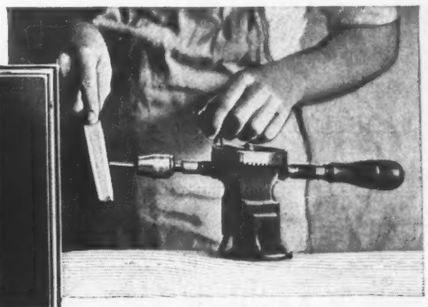
Five "Other Uses" for the Hand Drill

Beginning a series of pictures showing how to Make the Most of Your Tools

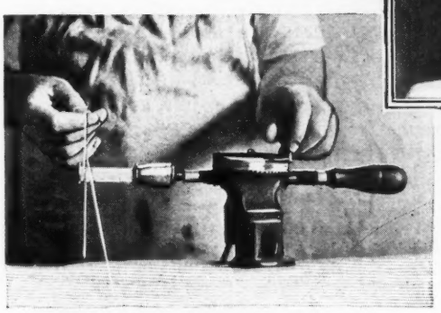


The rubber band "motor" of a model airplane can be wound up with the useful little hand drill. This illustrates how the trick is done

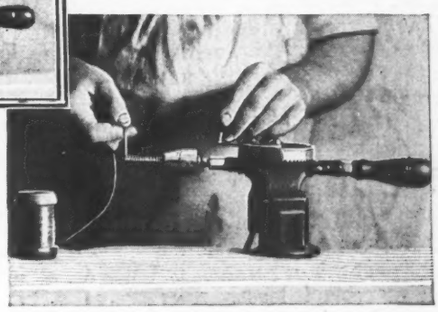
Small parts can be neatly polished with a hand drill gripped firmly in a vise. Hold a piece of emery cloth tightly about the article with one hand and turn the drill with the other



A lathe is readily improvised by placing the hand drill in a vise. This is the correct way to reduce the diameter of a rod by filing when a lathe is not at hand



It is easy to solve the problem of winding magnets if a drill is used as shown above



To wind a spring, place a mandrel in the drill chuck and wind the wire on it

Rubber Suit Keeps Jockey Down to Weight

THE man or woman who wants to reduce can borrow many a valuable tip from the racing-track, for in order to keep their weight down to the minimum, the jockeys undergo a course of training as rigorous as that of the pugilist. Even when they diet and exercise to the point of physical suffering, they frequently find themselves too heavy. In this predicament a rubber suit is used to keep them in riding form.

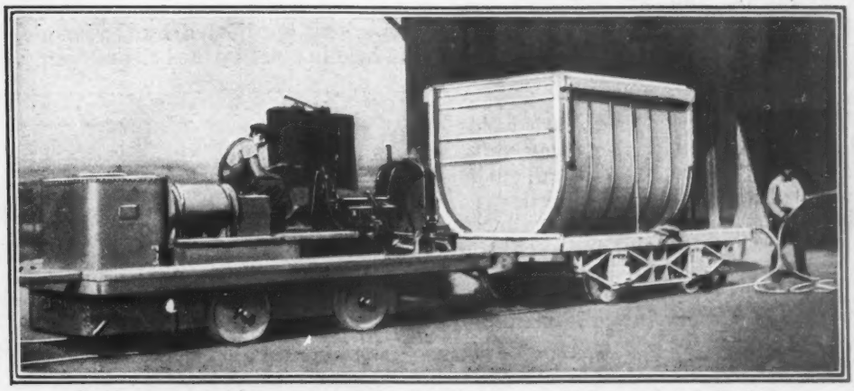
The illustration shows Albert Johnson, reputed to be the best post-rider in America, wearing a two-piece reducing suit made of thin rubber, which is tied at the wrist and ankles and tightly laced down the front so as to be airtight. After exercising strenuously in such a garment, the perspiration pours off the body, and while it is as uncomfortable a piece of clothing as human ingenuity can devise, it is guaranteed to take off the surplus flesh in an astonishingly short time.

A close-fitting rubber suit induces perspiration and reduces bodily weight

Homemade Spraying Outfit Runs on Ranch Railroad

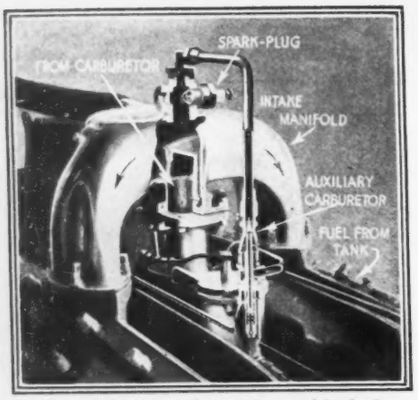
BECAUSE the spraying outfits supplied him were not big enough to take care of the immense farms under his direction, the foreman of a large Western ranch went ahead and assembled this spraying-train according to his own ideas.

An old motor-truck engine was transferred to the homemade locomotive, and made to do double duty in driving the outfit and operating the pump. The unit operates over the ranch's railroad, and is used for all kinds of spraying—not only for combatting scale and rust, but for whitewashing the ranch buildings and giving the hogs a bath.



Besides operating the spraying-pump the old truck-engine on this homemade train furnishes the motive power that drives it over the ranch railroad

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly



By pre-heating the cold gas this fuelizer makes easy work of starting the engine in cold weather

Fuelizer Preheats Gas for Easy Starting

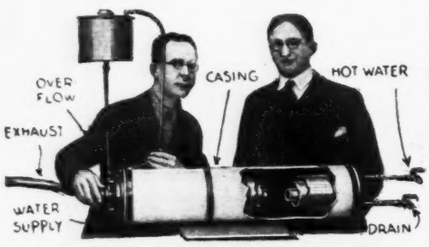
ANOTHER step forward has been made in the better combustion of present-day automobile engine fuels by L. M. Woolson, a Detroit engineer, who has perfected a device called the fuelizer, to heat the incoming fuel when the engine is starting and idling, and to automatically become inoperative when the engine is able to supply its own heat. This is a new principle because the hot-spot manifold and the exhaust-heated intake provide the engine with no heat when it is starting; slight heat when idling, and a maximum of heat when running but when the engine needs it least.

The fuelizer instrument consists of a burning chamber where the gas from a small supplementary carburetor is burned. This chamber is situated in the intake manifold at the top. When the gas enters, it is ignited by a regulation spark-plug. It then passes into the fresh charge, going from the carburetor to the cylinders from the regular carburetor. The heat of the burnt gases changes the wet, poorly carbureted mixture to a dry vapor which explodes efficiently and fully when it is ignited by the spark-plug in the cylinder.

Water Supply on Auto Heated by Exhaust

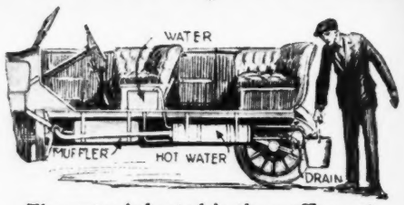
UTILIZING the heat of the exhaust gases to supply pure hot water in large quantities is the purpose of the latest accessory to be attached to automobiles and motor-boats. The advantage of the invention is that the water produced is pure—clean enough to use for bathing or even for making tea.

Those who like to make long trips by road or water, taking their own camping equipment and bivouacking by the roadside, know how keenly the lack of hot water is felt.



Messrs. Spates and Rumery demonstrate the operation of their automobile water heater

The appliance consists of a sanitary metal cylinder holding from two to twelve quarts of water, which is heated by passing the exhaust of the motor engine through a tube in the center of the container. The gases never come into contact with the water. The exhaust is diverted from the pipe leading to the regular muffler by a cut-out valve, and after the water has been heated, which takes about ten minutes, the valve is closed and the muffler utilized again. The pipe in the inside of the water container is in the form of a muffler, so the action of the heater is noiseless.

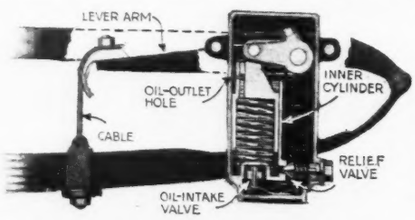


The water is heated in the muffler and then stored under the seat, from which place it is drawn off for use

A reserve water-tank to supply the heater is carried in a tank under the front seat of the car, and the hot water is drained off through a stopcock at the rear of the chassis.

Oil Shock-Absorber for the Automobile

GREAT wearing qualities are claimed for a new shock-absorber which works in oil on the principle of a big gun-recoil chamber. The action is entirely vertical, for although the plunger is fastened solidly to the car frame, it is attached to the spring by means of a cable which accommodates itself to lateral movements. All of the more sensitive parts of the appliance are entirely immersed in oil. This makes their action smooth and easy, prevents wear and lessens noise.



This new shock-absorber works on the principle of the gun-recoil chamber

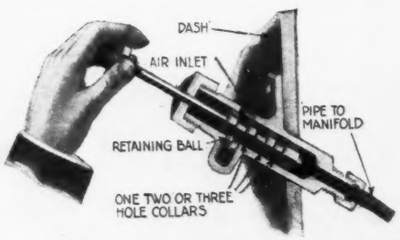
The absorber consists of an elliptical outer cylinder, which is filled with oil to a plug on the top. Inside is a second vertical cylinder having a piston and rod to the top of which is fastened, through a system of small levers, an arm carrying the cable attached to the spring at its midpoint. On the rebound of the automobile spring, the lever arm is pulled down and it exerts pressure on the piston of the inner cylinder. This forces the oil out of a small hole into the cylinder. As soon as a definite maximum pressure has been reached, a second valve at the bottom of the inner cylinder opens automatically. This valve compensates for any changes in the viscosity of the oil due to temperature.

In cold weather, when, of course, the oil is more viscous, the second valve opens earlier and wider, thereby keeping constant the pressure that regulates the spring action. When the automobile spring is again compressed, the piston in the inner cylinder is forced back to its top or normal position by a coil-spring below the piston-head, at the same time drawing oil into the cylinder through a valve at the bottom.

Valve Admits Gas, Kerosene, or Air

PRIMING the engine, cleaning the cylinders, and an auxiliary air-control are all possible with a new auto accessory attached to the instrument board and connected with the intake manifold by a small copper pipe. A piston consisting of four disks inside the cylinder forms a three-way valve having one, two, and three small outlet holes in the respective compartments. Similar holes are bored in the cylinder itself near the mid-point and at the top of the stroke.

Gasoline, kerosene, or air is drawn from the accessory into the manifold by the suction of the engine. This primes the engine, cleans out carbon, or controls the mixture. The volume supplied depends upon the valve's position. This is adjusted by the handle, and held in place by the bell and spring.



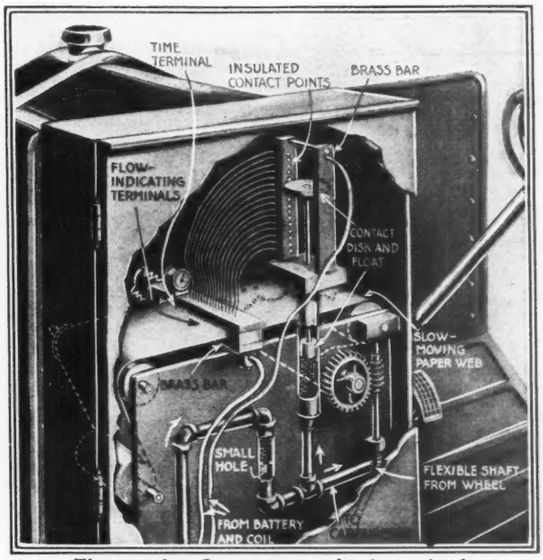
By pulling out the plunger either air, gasoline, or kerosene in any proportion may be admitted to the cylinders

Gasoline Flow Meter Records Effect of Road Condition on Car-Operation Cost

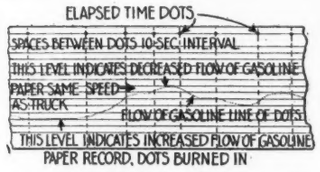
A FLOW meter which records the rate of gasoline consumption of an automobile engine at each instant of operation or point of travel has been developed by the Iowa Engineering Experiment Station to determine the effect of the condition of the surface of a road upon the cost of operation of motor-cars.

The flow meter operates on the principle of the loss of head in a liquid when passing through a small orifice. A constant head of gasoline is maintained, and the size of this orifice is such that the rate of flow of gasoline through it is just a little greater than the consumption of the carburetor. This difference causes the gasoline to rise in the float tube, and hence the relative height of the float indicates the rate of consumption of gasoline by the carburetor at that instant.

The recording mechanism consists of a stem attached to a float carrying a small fiber contact disk at its upper end. This disk, which has a small piece of copper wire wound around its edge, moves up and down in a tube over eighty small brass contact points at vertical intervals of one twentieth of an inch.



The complete flow-meter mechanism. As the gasoline flow varies, the plunger moves up or down, causing sparks to burn minute holes through the paper record


ELAPSED TIME DOTS
SPACES BETWEEN DOTS 10-SEC. INTERVAL
THIS LEVEL INDICATES DECREASED FLOW OF GASOLINE
PAPER SAME SPEED AS TRUCK
FLOW OF GASOLINE LINE OF DOTS
THIS LEVEL INDICATES INCREASED FLOW OF GASOLINE
PAPER RECORD, DOTS BURNED IN

A sample of the paper record. The curved line indicates the variation in the gasoline flow as the condition of road became better or worse

Each of the eighty brass contact points is connected with one of a corresponding row of points on a bar of insulating material below which a strip of record paper moves. Underneath the paper and directly opposite this row of points is a small brass bar which is connected with a continuous brass strip in the contact tube through a battery and a high-tension spark-coil. When the circuit is completed by the contact disk on the float stem, making contact between the brass strip and one of the brass points in the contact tube, a spark jumps from the corresponding point above the record paper to the brass bar below, burning a small hole in the paper.

As mounted on the cowl the flow meter takes up but little room

As the float rises and falls with variations in the rate of gasoline consumption, the position of the row of holes on the moving strip of record paper will change correspondingly.

The record paper moves at a rate exactly proportional to the speed of the vehicle. An ordinary alarm-clock movement is arranged to close a high-tension electric circuit through the edge of the strip of record paper at regular intervals of twelve seconds.

Needle-Valve Control for Fords Saves Gasoline

THE operating expenses of the average Ford car could be reduced if the driver had the gasoline control within sight and reach. This is the case with the more expensive cars, but on the Ford the driver must reach in back of the instrument board before he can adjust the carburetor needle-valve. Because of this difficulty in making adjustments, many Fords are run at less than their highest efficiency and with a much lower gasoline mileage than might easily be obtained.

To make this economy possible, George G. Porter, an engineer of Syracuse, New York, has devised a simple gasoline control apparatus which brings the needle-valve regulation to the very fingertips of the driver, and eliminates all groping behind the instrument board, an awkward practice and a menace to careful driving. The means of control can be installed in a few minutes without the services of a skilled mechanic. First the regulation Ford adjuster is removed; a hole is bored in the instrument board and the rods and levers connected as shown in the sketch at the left. In the hole in the instrument board is inserted a neat dial on which is mounted a pointer, which indicates the exact position of the needle-valve at all times. By reason of this knowledge, the danger of overheating the engine and causing pre-ignition or the excessive deposit of carbon in the cylinders is reduced to a minimum. The control also serves to make it easier to start the engine in cold weather by indicating the amount of gasoline being fed to the engine. For Fords not fitted with instrument boards a small, sheet-steel apron is made especially to accommodate the dial.

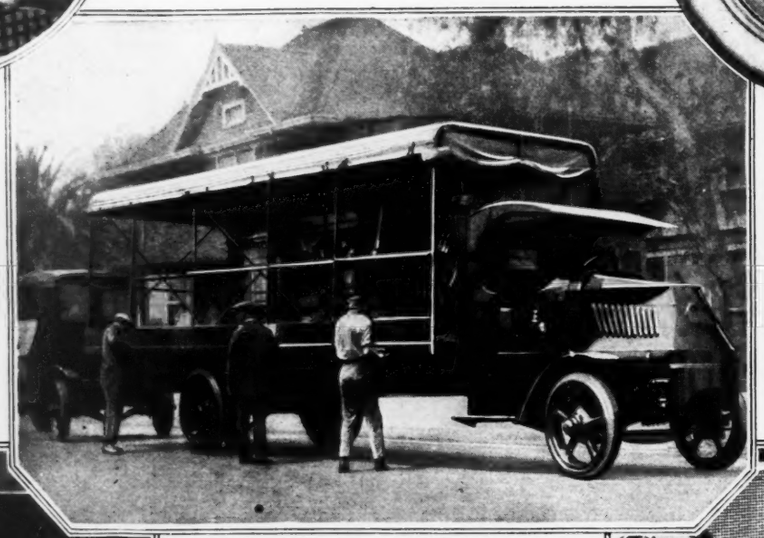
A simple gasoline control dial on the dash permits instant adjustment of the Ford carburetor

Picture News of Recent Developments in the Motor World

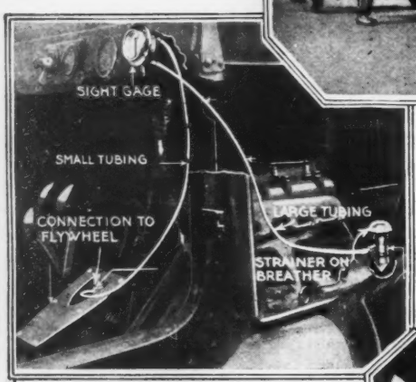
As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned on this page

Your name and club emblem embossed on a copper or silver plate can be securely attached to the car radiator with the fingers, and needs a jimmy to take it off. Everybody has a monogram on the door, but this idea is comparatively new

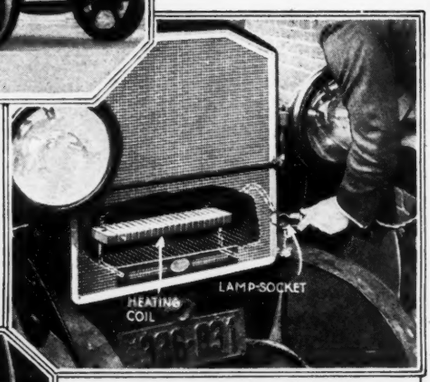
Complete rim-changes in less than three minutes are claimed for these lugs, which open and lock with a three-quarter turn. They attach to the old lug bolts, and need not be removed when a tire is changed



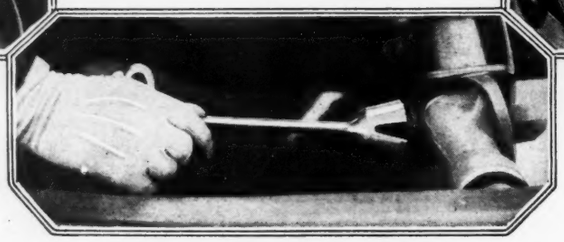
Prospective purchasers can examine the under mechanism of this truck without crawling beneath it. The chassis is mounted on a larger truck, and when the demonstration is over the moving showroom cranks up and moves to the factory of the next prospect



Visible oiling systems for the Ford give the driver advance notice when the regular lubricating system is clogged and make burnt-out bearings one of the other fellow's troubles

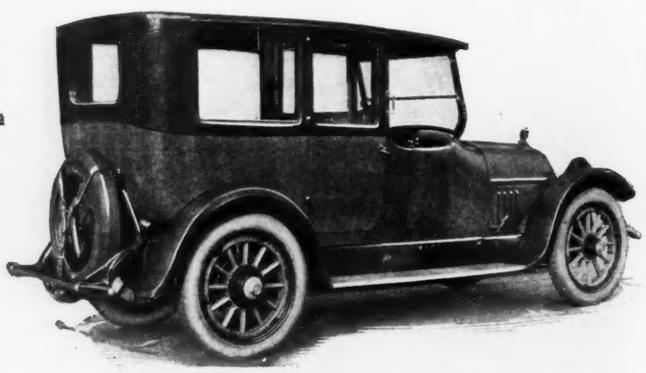


An electric heating-coil beneath the radiator operating on the lighting circuit makes it unnecessary to heat the whole garage to keep the radiator warm



Grease-cup handles which fit any cup get the grease into the bearings and not under the finger-nails

At last! A battery terminal which fits any spark-plug, without nuts or locking devices, and yet which cannot be jarred loose



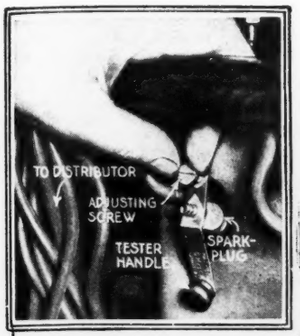
You can now leatherise your car with a fabric cemented to the body which looks like leather of any grain or color, but which is inexpensive, permanent, and easily cleaned

Grease cannons which fill the grease gun with a plunger save time and permit garages to retail their contents without any waste

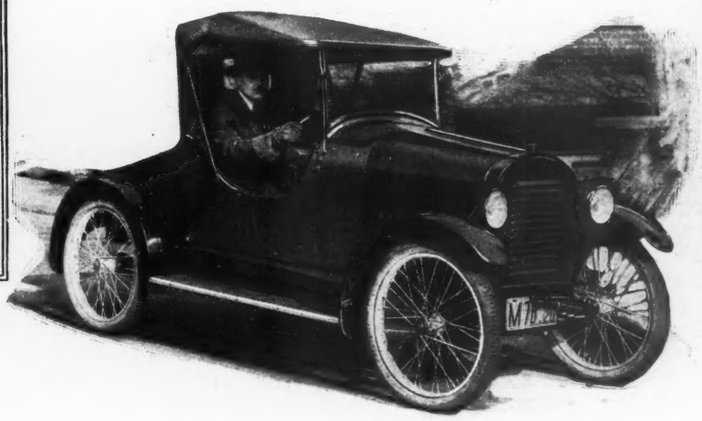
When You Want Expert Advice About Your Car

IN these pages of ideas about automobiles and motor-trucks the Popular Science Monthly endeavors to help its readers solve problems of maintenance and repair. But there must be special cases that are not covered, and we invite you to write to the Automobile Editor and let him advise you.

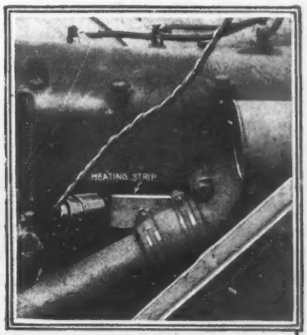
If you wish to know more about the devices pictured here, or if you want to ask questions, write. See a few typical answers on page 81.



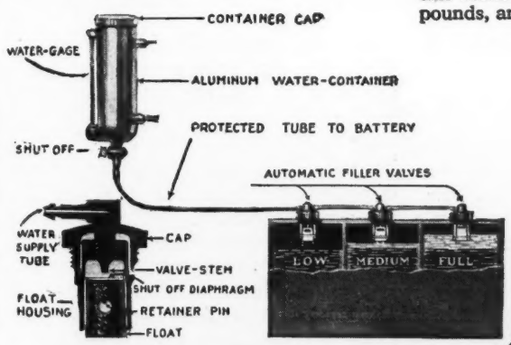
Intensification of the spark by passing the battery current between a flat surface and a point, and a tester which short circuits the plug by depressing a spring key are the features of this attachment



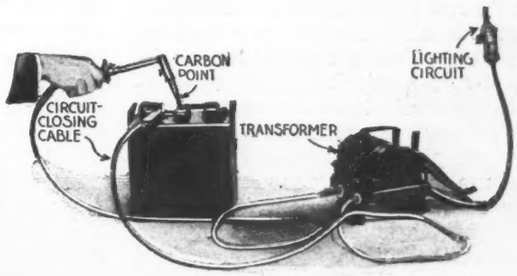
Twelve hundred pounds lighter than the usual small car, this model tips the scales completely equipped at 840 pounds, and is operated with a corresponding saving in gas and tires



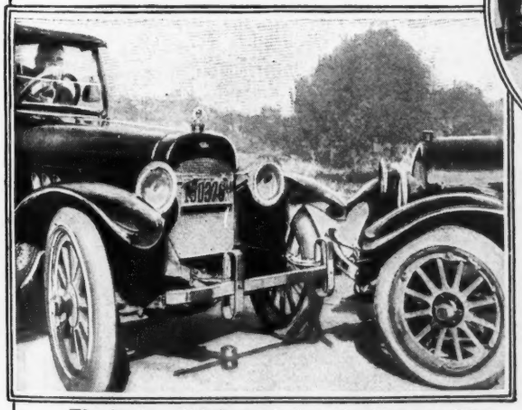
Hot water about the garage is supplied by slipping this electrical heating strip into the bucket of water, as the heating unit is enclosed in a watertight welded cover. Useful also for keeping the engine warm on frosty nights



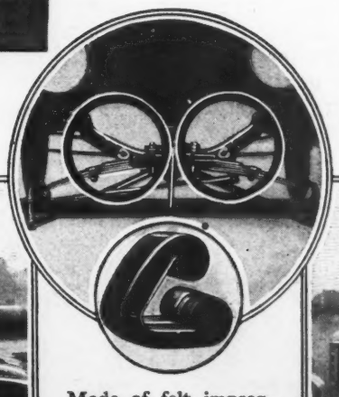
By replacing the storage-battery vent-caps with automatic filler-valves, this system will supply distilled water to the storage batteries whenever needed



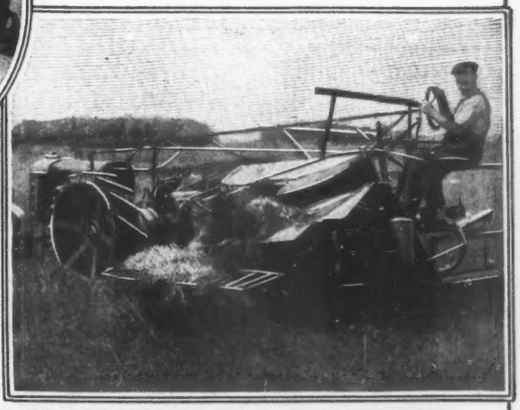
Whenever storage batteries are taken apart the lead strip joining one to the next must be cut. Doing this with the carbon tool above instead of a blowtorch removes the danger of burning the insulation



The brakes didn't work, but the bumper did, and there is no garage bill as an aftermath of this collision. The vertical springs enable this bumper to fend off cars of every height



Made of felt impregnated with oil and held in shape by springs, this oiler is inserted between the channel frame and top spring leaf of a Ford. Every movement of the springs automatically brings the oiler into play



A long steering-wheel permits this tractor-drawn reaper to be handled by the operator from his regular position on the rear of the machinery

This Electric Automobile Has Sixty-Mile Radius with Low Operating Cost

May revolutionize transportation around town for family of moderate means

THE appearance of a small, high-quality, economical electric automobile suggests a new chapter in the romance of transportation. Here is a practical car for every man and woman, with price and upkeep well within reach, built by an established company with a reputation based on the manufacture of industrial tractors of about the same size.

Not a Big Car's Competitor

This new electric has capacity for two passengers, and a cruising radius of sixty miles at fifteen miles an hour, with a maximum speed considerably higher. It has a wheelbase of sixty-five inches and a tread of thirty-five inches; the tires are twenty-eight by three inches. The car's smallness, simplicity of control, ease of operation, and reliability—the last three qualities being peculiar to the electric in high degree—give promise that it will not compete with its bigger, livelier, more costly gasoline brother, but will build up its own especial field of usefulness. The low-priced electric may even become every family's substitute for the street-car, furnishing more comfortable transportation at the same cost.

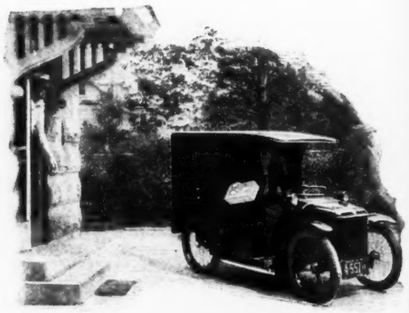
The new car comes in three models—a two-passenger runabout for general use, a two-passenger car specifically designed to carry a factory executive from building to building and through the buildings of his plant, and a small delivery-car, particularly for those whose hauling requirements are light but exacting. Among tradesmen and merchants in this class may be mentioned jewelers, tailors, laundrymen, newsdealers, druggists, etc. As a special delivery vehicle a car of this type may also appeal to butchers, grocers, florists, and the like, and it is not absurd to expect that it will appeal to many private families as a marketing-car and luggage-carrier.

American manufacturers may find the possibility of popularizing vehicles of this kind for general family use most enticing. It is the nearest thing to a pair of electric legs that can possibly be imagined. It pictures the ultimate in personal transportations. Without pretense or show; just large enough to comfortably carry two people; with a cost of operation that compares favorably with the gas-bill or the laundry-bill; with such simplicity of control that even the most timorous elderly lady or the most nervous child has a complete sense of mastery over it. With all these possibilities, the eventual popularity of vehicles in this class must be considered assured.

Few appreciate the extraordinary simplicity of the electric car. It is steered by one lever and started and stopped by another lever. Forward movement of the latter from neutral starts the car and a backward movement applies the service brake. Unlike the gas-car, it is never necessary to do two things at once. There is just a single lever with a natural motion: forward to start, and backward to stop. A second brake is operated by a pedal. The control lever gives three "speeds:" top speed for running along the level and the other two for hill-climbing.

Another advantage of "electrics" that only those who have ridden in them understand, is the complete absence of noise.

The upkeep is almost negligible. The cost of electric current is but a few cents a day. A charging apparatus is furnished with every car so that the owner can take care of this detail in his own home. The battery is connected with the electric supply at night and it is ready again in the morning. Tires are a minimum size, the standard size for motorcycles, and consequently are extremely cheap, yet their life must be long because of the gentleness of the service which an electric imposes.

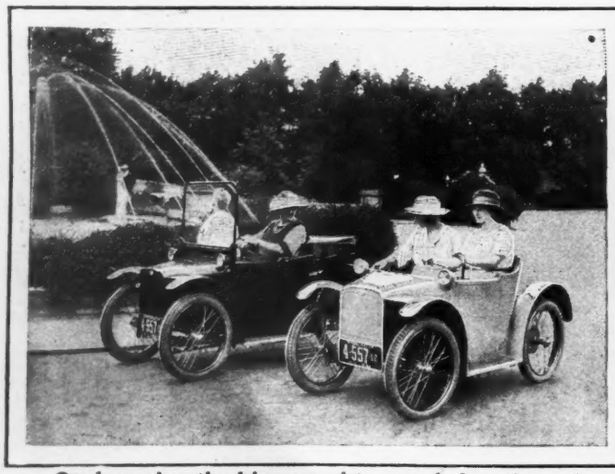


Thousands of business houses will find the electric car indispensable for rapid deliveries. Its low upkeep commends it

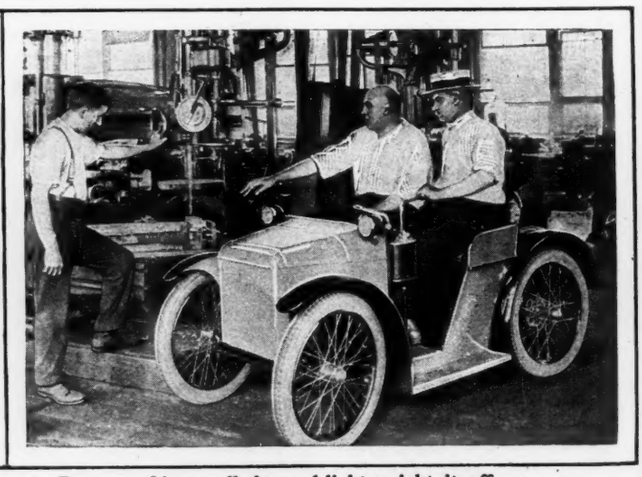
Repair Costs Are Insignificant

Repair expense should be nearly nil. Virtually the only moving parts are the wheels, driving chains, and the motor armature.

Such a car should be ideal in traffic because of its smallness, and the cost of garaging it should be reasonable for the same reason. Its dimensions over all are less than four by eight feet, whereas the average automobile is six by fifteen feet. Calculating garage costs, therefore, it is logical to expect that if a building were specially designed to house vehicles of this size, the rental would be half the present rate. From a garage standpoint it is most attractive for the house-owner. Its



One lever gives the driver complete control of starting and stopping the automobile with a three-speed range



Because of its small size and light weight it offers convenient transportation for executives on inspection tours

size is such that there are few front porches under which it would not fit with but slight modification. If there is room for a separate garage at the rear of the house, and room for a narrow drive at the side of the house, the size of building required would be about six by ten feet by seven feet high—420 cubic feet—as compared with the average small garage, which is eight by fifteen feet by eight feet high, or a total of 960 feet.

The factory car fills a long-felt want in industrial plants and is of special interest to factory managers, executives, plant owners, etc., since it provides quick, convenient intershop transportation and saves the time and energy of the busy executive in making inspection and keeping in touch with the various departments. In other words, as a factory passenger-carrying vehicle it is as much needed as the industrial tractors used to-day are needed for carrying material. A certain production manager once stated that in busy seasons he walked twenty miles a day, and considering that the main plant under his supervision is nine hundred by fifteen hundred feet, it is easy to realize the truth of his claim and also to appreciate the field there is for transportation as supplied by this small electric.

Although this car is small and reasonable in price, there is nothing cheap about its construction. Axles, frame, springs, and other parts are of the best quality steel, the body is of aluminum and is upholstered with genuine leather. The equipment includes an ampere-hour meter, horn, and electric lights.

$50 for the Best Stories of Auto-Camping Experiences

ARE you one of the thousands who went camping by automobile this year? If you took a motor vacation, if you made your car your home while you camped, or traveled or lived in the open, tell Popular Science Monthly all about your experiences.

A First Prize of $35 and a Second Prize of $15 will be awarded for what, in the opinion of the Editor, are the two most interesting and informative letters. Letters must not be more than five hundred words long. The contest closes January 10, 1922.

Tell all about your trip, where you went, how much it cost, and what automobile-camping accessories you used or devised.

Write to Us About Your Motor Troubles

If you have a motor-truck or automobile problem, let the Automobile Editor solve it

Do Tires Require Exercise?

Q.—Is there anything in the claim that tires require hard exercise to keep them in the best of condition?—H. W. C., Austin, Texas.

A.—Some experienced motorists and some tire men claim that tires stand up best when subjected to hard and frequent service, lasting much longer under this treatment than they do when used gently. There is no authentic proof that this view is either right or wrong. The belief seems to be based on the fact that men classed as hard drivers often obtain extraordinary service from their tires. For example, there is the case of a man owning a high-powered car that weighs 5000 pounds and is equipped with 35 by 5 cord tires. Most of his driving is done at high speed, yet he never obtains less than 15,000 miles and 20,000 is far from unusual for the life of a tire. It is instances of this sort that have led some to claim that hard and frequent exercise help to prolong tire life.

Causes of Engine Heating

Q.—What are the most common causes of automobile-engine overheating?—A. X., Paterson, N. J.

A.—The most common causes of engine overheating in the usual order of their importance are a loose fan-belt; inadequate water supply in the cooling system, or a leaky radiator; clogged water-jackets or hose connections; insufficient oil or old oil; incorrect spark advance and carbon in the cylinders.

Horsepower-Weight Ratios

Q.—Is there a fixed ratio between engine horsepower and weight of the passenger automobile and motor-truck, and if so, what are the most usual ratios for the two types of vehicles?—J. S., Los Angeles, Cal.

A.—There are no definite fixed ratios between horsepower and weight, these varying according to the design of the car and the purposes for which it is intended. Some speedy passenger-cars have 1 hp. each 50 or 100 lbs. of weight. Others have 1 hp. each 150 lbs. weight, and the ratio increases up to 1 hp. each 300 or 400 lbs. of weight in slower-speed trucks of large capacity.

Heavy Oil for Old Engine

Q.—I have an old car that has a high oil consumption. No doubt reboring the cylinders and fitting new pistons and rings would cure the trouble, but I do not wish to go to this expense. What can you suggest?—J. W. P., Topeka, Kansas.

A.—Try using heavy oil. Drain the present oil out of the crankcase, put in a gallon of kerosene, and run the engine for a minute or so. Then drain out the kerosene and fill reservoir with heavy oil. The reason for recommending heavy oil should be obvious. It is thicker and flows less readily, therefore less of it will make its way up into the combustion chambers. At the same time, the parts of the engine are so well worn that there is space for this thick lubricant to flow to all points requiring it.

Tire Size *vs.* Differential

Q.—My car is equipped with 32 by 3½ inch tires. Will it do any harm to put a 33 by 4 inch tire on one rear wheel?—E. M. G., Springfield, Mass.

A.—The practical answer to this question is that it is being done every day, and owners report no bad results. But difference in tire diameters wears the differential gears and the speed with which these gears give out in some cases is only explainable by unequal tire sizes. The gears referred to are the small pinions—not the ring gear or ring-gear pinion. If rear tires are invariably of the same diameter, these gears are only in action when the car is traveling a curved path; but if these tires are not of the same diameter, they are in action continuously to an extent proportional to the ratio of the tire diameters. In considering this problem, actual tire diameters must be thought of, taking into account whether tires are pumped hard or not, whether their treads are worn or new, whether the tires are large or small, according to their nominal size, and, finally, whether they are the same nominal size or one is an oversize. In view of all these factors, it is not difficult to imagine a car with one rear tire of two or three inches greater diameter than the other rear tire.

What Produces a Backfire?

Q.—What produces a backfire and how does it differ from a muffler explosion?—M. C. B., Pueblo, Colo.

A.—A backfire is due to the burning mixture in the cylinder setting the gas in the intake manifold on fire. A muffler explosion is caused by unburned charges of vaporized mixture being delivered from a missing cylinder to the muffler to be set on fire by hot exhaust gases from the succeeding cylinders that are firing.

The backfire is usually caused by a weak mixture or cold engine. The condition may be aggravated by a retarded spark. The weak mixture may be caused by improper carburetor setting or dirt in carburetor or pipe line. If hot-air connection ceases to work, backfiring may result. Other causes of this trouble include intake valves that stick, intake valves that leak or have weak springs. Incorrect valve-timing might also cause the difficulty.

Why Some Tires Wear Out So Rapidly

FARMER JONES found his young neighbor Brown closely examining the right front tire on his light truck. Noting his perplexed look, he asked, "What's the trouble here?"

"This tire seems to be wearing faster than it ought and I'm wondering if the wheel can be out of alinement," replied Brown.

"Don't you know how to find out?"

"Yes, I tried measuring, but it seems to be all right."

Jones examined both tires carefully, then observed, "That tread does appear to be wearing unevenly. Well, we will make sure. Get me a clean piece of paper—sheet of soft white, not tough paper.

Brown complied. Jones took a sheet, wet it, and then laid it on the smooth floor directly in front of the offending tire. He made sure it adhered tightly to the floor, and then wiped off the surplus moisture with a dry cloth. He took another sheet, and after treating it exactly like the first, placed it on the floor in front of the other front tire.

If your tires wear out too fast, test the wheels of your car as suggested by Farmer Jones

He then asked Brown to start the engine and after cautioning him to hold the steering-wheel so as to drive straight ahead, had him drive only the two front wheels over the moistened sheets of paper. Brown stopped the truck before the rear wheels reached the paper. Then both men examined the two sheets of paper. The left one showed the clear impression of the tread and was untorn. The right appeared to have been pushed inward and the tread had ruffled and torn through the paper in spots.

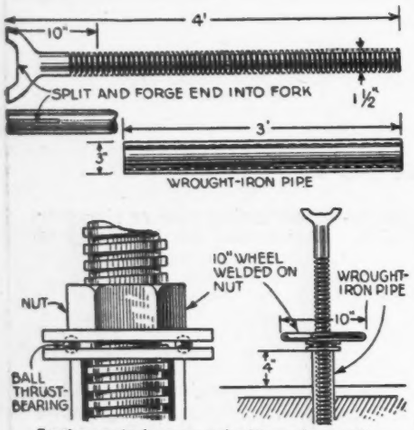
"Something wrong here," asserted Jones. "You say you measured between the wheels and found nothing wrong? Well, let me have your jack."

He jacked up the right front wheel, shook it, and it wobbled on its bearings.

"Looks as though we have found the trouble," he remarked.

They took the wheel off and found the bearings loose, allowing the wheel to stand straight at rest, but causing it to wobble when the truck was in motion. They remedied this and the wheel ran true again.

Ball-Bearing Stationary Jacks for the Garage



Stationary jacks are a valuable equipment for the garage and safer than movable jacks

ONE of the most desirable features of garage equipment is a means of hoisting either the forward or rear ends of the car enough to bring the wheels 2 ft. above the floor. This permits of the periodical repair of the chassis and makes it possible to get underneath readily for cleaning, greasing, and inspection, which work is neglected where the owner is obliged to get down on the cold dirty garage floor.

If two 3-ft. lengths of 3-in. iron pipe are embedded in the concrete floor at the time the floor is placed, leaving the ends protruding about 4 in. above the floor level, two removable screw-jacks with forked upper rests can be used to elevate the car to the desired position. These jack-screws are made from bar stock 1½ in. in diameter and the forked rest is forged out of the end of the bar. It is desirable to have the thread lathe-turned on the bar, making a square thread with a screw lead of about ⅜ in. The lifting-nut should be made of corresponding thread, and for convenience in turning a rim about 10 in. in diameter should be welded to the nut.

Two ball thrust bearings (for ease in turning the nut on the screw) are placed between the pipe and the nut. While the threads can be put on the bar with a die, the pitch is usually low and more time is required to raise the car. The space between the elevating jacks should be made the same as the distance between the outer frame members of the car's chassis. The cost of these fixtures will be low, as the threading can be done in any machine-shop. The ball thrust bearings need not be new; suitable parts can be purchased from dealers in second-hand material.

Keep the threaded bars well oiled and the device will work smoothly and fast. In lowering the car, a steep pitch thread will practically lower itself; the nut is given a quick turn, and the weight above tends to keep it spinning until the car wheels are on the garage floor.—G. A. LUERS.

Several Different Ways of Cleaning Ink-Bottles

INK-BOTTLES invariably become coated on the inside with dried ink, which adheres firmly to the glass and does not yield to water. There are several methods of cleaning such bottles and they depend for their success on the nature of the ink.

The best method is to put a handful of small bird-shot in the bottle, fill it about half full with water and shake the bottle and contents vigorously to remove the coating of dried ink by the friction of the lead shot against the sides of the bottle. This will remove the greater part of the coating. What is still left may be removed by emptying the shot and water out of the bottle and putting about a thimbleful of hydrochloric acid in the bottle and rinsing every part of the inside of the bottle with the acid until the ink is dissolved.

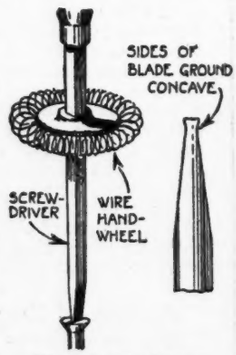
Oxalic acid or one of its salts may also be used for this purpose, but it is a violent poison and must be handled with great caution. The hydrochloric acid also is poisonous and highly corrosive and should not be permitted to come in contact with the skin or any fabrics. When the coating of ink is very heavy, it is sometimes found necessary to repeat the cleansing process.

Aniline inks do not resist cleansing as the iron-gallate inks do. One ounce of denatured alcohol used for rinsing the bottle thoroughly will usually remove all the remaining ink. It is advisable, however, to repeat the rinsing at least once more before giving the bottle its final ablution with water.—HERMAN NEUHAUS.

Improve the Screwdriver with a Valve-Wheel

BY adding a valve-wheel, as shown in the illustration, to the blade of the screwdriver, the work of twisting the screw is less tiring and the work progresses more rapidly.

A wire-rim wheel is preferable, as this affords a good gripping surface for the hand; however, a cast-iron or wooden rim will improve the screwdriver if either of these is available.



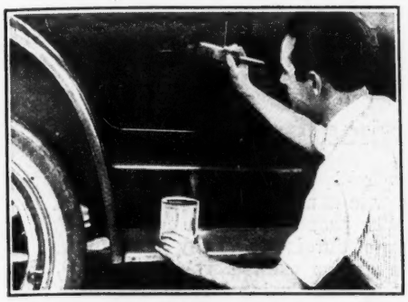
The hand-wheel shown above will give more power for turning the screwdriver

The wheel is added by squaring out the center enough to permit it to be driven solidly over the blade. After adding the wheel, the blade should be ground as shown to put it in good condition for the screw slots. This makes a dependable tool, serviceable for the hardest screws.

MAKE an India-rubber printing-block, either by cutting or from a zinc or an electro cut, moisten it with fluorhydrate of ammonia and hydrofluoric acid, and apply it to the glass for a few moments. It will etch it, but so slightly, that the picture can only be seen when breathed upon. This might be put to commercial uses, such as on store windows, or for novelties.

Saving the Body Finish of the Automobile

IN spite of a good paint job and exceptional care, a car does sometimes undergo a little rough treatment and the result is a chipped-off place or two on the lustrous finish of the body. Once a chip



When car enamel chips, scour the spot with emery and cover with shellac

has been loosened, water soon forms rust between the paint coats and the metal of the base. As this rust spreads, the paint around the bare spot becomes loosened and in time more paint comes off.

If this happens with your car, carefully pry off the loose paint about the bare spot with a penknife blade, until clean metal is exposed. This increases the size of the blemish, but this is better than having it gradually grow larger.

With a small piece of emery-cloth, scour the metal surface until it is bright, and then coat with a little shellac so that all of the metal is covered. By carefully working the shellac into the corners of the blemish; and sealing the whole against the air, the spot is effectively protected from rain and other damage.

By mixing a little lampblack or other color into the shellac, the coating may be made the same color as the rest of the automobile body.—DALE R. VAN HORN.

Blinker Signaling with the Car's Lamps

MEMBERS of automobile parties are sometimes separated by lakes or streams too wide for the human voice to cross, and without telephone service. With automobile lamps and a card showing the international Morse code, conversation can be carried on without difficulty.

A hat can be used as a shutter. First cover the light. Remove the hat for half a second and quickly replace it. A Morse "dot" has been transmitted. A "dash" is three times as long as a dot.

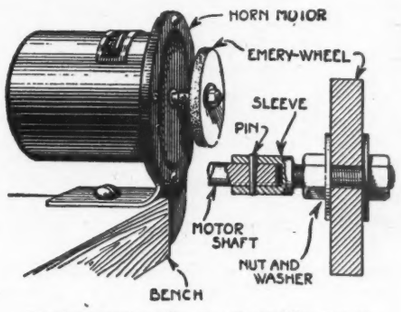
It is not necessary to learn the code. Just hold a copy in the hand and the letters can be found rapidly enough for practical purposes. In receiving a message, the dots and dashes may be put down as they come and translated later. Be sure to put in the intervals correctly. The space between dots and dashes in a letter is the length of the dot, while the space between letters should be three times as long. Between words still more space should be given.

By throwing the light up in the air signals can be transmitted over a hill of considerable height. The use of field-glasses for receiving may make it possible to receive messages from a point twenty miles away or even farther.—A. PERRY.

When you are separated from your fellow tourists at night, signal them with your lamp

Horn Motor Converted into a Grinder

THE motor part of an automobile horn can be converted to a small high-speed grinder for use in the private garage in sharpening small tools, drills, knives, chisels, grinding coil contact points and similar work. The funnel of the horn or bell is removed and in place of the ratchet



The horn-motor of your automobile may be used to drive a small emery-wheel

disk a sleeve is driven over the armature shaft and riveted on.

This sleeve is threaded and fitted with two nuts and washers for holding the emery-wheel. The usual bracket that clamps the horn to the car is used for securing the improvised grinder to the edge of the workbench. With an extension lamp-cord the motor can be run by the storage battery in the car.

In view of the exceptionally high speed at which these motors run, only a small emery-wheel is required. This is a very compact tool and if desired can readily be carried in the tool-box of the car while touring.

Danger Due to Loss of Ford Front-Spring Center Bolt

SHOULD the clips of the Ford front spring get loose enough for the center bolt to be pulled apart or sheared, it is dangerous to drive the car. The only connection between the front axle and frame when spring clips are loose is the center bolt. Without this the frame can shift sidewise, and in doing this the steering-arm will lock and possibly ditch the car. Inspection of these clips before undertaking an extended drive is a wise precaution to take.—G. A. LUERS.

How to Make a Rain-Visor for Your Car

HERE is a rain-visor that is made of galvanized iron, can be flattened and stowed away when not in use, and can be placed in position quickly when a sudden shower comes up.

Secure a sheet of galvanized iron 2 ft. long and about 16 in. wide. With a pair of

If you have no rain-visor on your automobile, you can easily make one by following the directions given here

sharp tin snips cut out a section similar to that shown in the picture below.

Two bends are then made that form a three-sided box, not too bulky, yet large enough to give ample vision when in place.

Four holes are punched through the corners of this visor and short lengths of wire inserted and bent to form hooks. These hooks slip over the top and bottom rims of the upper half of the wind-shield to hold the visor in place.

To prevent glare, the iron sheeting may be covered with asbestos or cotton by coating the visor with shellac and laying the material on before the shellac has become hard. Another way to prevent

This shows the manner of cutting the sheet metal before it is folded to form the visor

glaring is to give the iron a coat of lacquer. When not in use, the bends are flattened out and the visor, now a flat sheet, is stored under the rear seat, or any other convenient place.

The Home Workshop

New and Useful Things for the Practical Man to Make

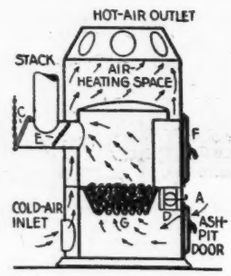
How to Run the Furnace Economically

By O. E. Ruhoff

THE relation between chemistry and the economical burning of fuel has been discussed often, but little, if any, attention has been given to the chemistry of the elimination of dust and smoke as applied to hot-air furnaces.

A definite quantity of air is necessary to properly and economically burn the particular amount of fuel needed under certain weather conditions. Referring to the illustration, this air is drawn in through the ashpit door *A*, which passes upward through the grate *G* and bed of burning fuel *F*, and, after having heated the fresh air to be delivered to the various rooms, leaves through a pipe *P* containing dampers, and passes out into the chimney. The various parts of the furnace through which the flame, gases, and dust from the fire pass, are supposed to be completely separated from the circulatory system through which the fresh air is passing while being heated for the rooms of the house. It is difficult to secure this condition continuously, especially in older furnaces, and, due to leaks between the two systems, dust and gases pass up into the rooms, unless certain precautions are observed. These can be carried out without a waste of fuel.

On a cold day much more air is necessary than on a mild day, when but little coal needs to be burned. When it is desired to burn less coal, the amount of air passing through the firebed is decreased by either (1) opening check *C*, and closing damper *D*, or (2) by closing the ashpit door or the damper in it, or (3) by opening the damper in the fire-door, or (4) by opening the dust-damper *D*. In these different methods of regulation, the only one that is likely to waste fuel is that of keeping the damper in the fire-door open too much, since this may draw in unnecessary cold air.



In a general way, all furnaces are built like that shown here

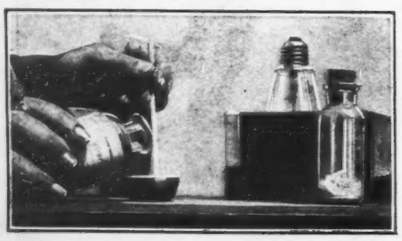
The proper procedure for checking the rate of burning is not by greatly reducing the suction exerted by the chimney, but rather by reducing the amount of air that passes through the fire, by keeping the ashpit door and its damper closed, or by temporarily opening the damper in the firedoor, or by leaving dust-damper *D* open. Do not forget, however, to close dust-damper *D* when the weather is cold, otherwise much air will go through the dust-damper *D*, instead of the firebed. It is not intended to imply that damper *E* and check *C* should not be used at all, but they should be used rather sparingly. However, when the furnace is being worked on, either to break up clinkers, remove ashes, and so on, it is important to keep check *C* closed, and have damper *E* wide open so that dust and poisonous gases may be drawn out of the chimney instead of backing up and leaking to the fresh-air pipes, or coming out into the furnace-room.

Hot-air furnaces differ in details of construction, and the illustration and above descriptive matter may not apply completely to them all.

To Etch and Frost Electric-Light Bulbs

ETCHING or frosting glass is by no means difficult to do if proper care is taken. Even an electric-light bulb can be frosted.

The materials necessary for etching on glass consist of a lead dish, powdered calcium fluoride, concentrated sulphuric acid, a glass rod, and some paraffin.



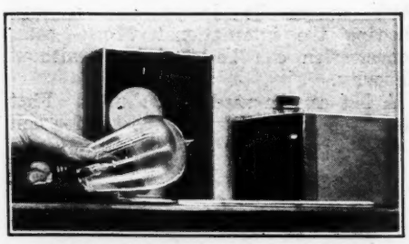
Pouring the acid down the glass rod held against the mouth of the bottle will prevent spilling the dangerous liquid

Before generating the fluorine gas, the object to be etched is entirely covered with wax. Then with a sharp knife all that part of the wax is removed from the glass to be etched. This must be done very carefully so that none will adhere to the glass, since the part to be etched must be absolutely clean.

Then the object is placed in a small cardboard box or a hole is cut into the lid of the box and only that part of the glass to be etched or frosted is placed through it. The space between the glass and the cardboard is closed with paraffin.

Before sealing the box the powdered calcium fluoride, which is absolutely harmless, is placed in the lead dish (⅛ oz. will be sufficient). Then concentrated sulphuric acid is added to the powder with extreme care and stirred with the glass rod so that it mixes thoroughly. Enough acid is added to form a thin paste. Caution must be used since the escaping gas is very poisonous and must not be inhaled. A lead dish is absolutely essential. Glass dishes can not be used, as they are quickly destroyed by the acid.

As soon as the paste has been made, the lead dish is placed in the cardboard box, and the cover placed over it. Of course, the object to be etched must be in the box with the lead dish. Leave the tightly sealed box undisturbed out of doors and covered with a wooden box so that it is protected from the dew. After the second day, take off the lid, remove the etched glass, rinse it in water, remove the paraffin, and the glass will be found to be etched on all those places where the glass had been exposed to the acid fumes. Do not forget to clean the lead dish by playing a stream of water on it until all of the paste has been removed, then dry it.—E. BADE.



The etching-box, its cover, and an incandescent bulb that has been etched are shown in this illustration

Timely Hints for Aiding Santa Claus

CHRISTMAS is approaching and the problem of providing presents is foremost in every one's thoughts. In the December issue of Popular Science Monthly you will find a number of suggestions for making Christmas presents. Full directions will be given, and only tools included in the home tool-chest will be required.

Methods for Removing Various Stains from Cotton, Wool, and Silk

Every household should be supplied with such an equipment as is here illustrated for removing all kinds of stains

MOST stains can be removed if they are given the proper treatment as soon as they occur. However, different stains demand different treatment. If, for example, you apply hot water to milk, egg, meat, or other albuminous stains, it will do more harm than good; yet this same hot water will easily remove fresh fruit stains. Similarly, soap that will remove grease spots to a certain extent, will set a fruit stain in the same material so that it cannot be removed.

In regard to the cloth itself, its nature, color, weave, finish, and weight must be taken into consideration before anything is done.

Cotton and linen are stronger than either wool or silk and can be given rougher treatment; however, if acid is used on cotton and wool, it must be immediately followed by an alkali or a thorough rinsing to prevent destruction of the fiber. Alkalis do not affect cotton and linen so much as acids, and the opposite is true for wool and silk.

Before applying acids or alkalis to a stain, try hot or cold water, according to the nature of the stain. When the stain is on linen or cotton fabrics, the material should be soaked in water; if on silk or wool, it should be sponged. If water does not wash away the spot, then a chemical should be applied. The work should be done rapidly to prevent possible destruction of the fabric.

Fruit or berry stains should be attacked immediately with hot water. If the cloth in question is white or is made of strong fast-colored material, boiling water may be used.

Silk and wool, however, are too delicate for such treatment; they should be sponged with warm water. If some of the stain remains after water treatment,

Fruit-stains may be removed by pouring boiling water from a tea-kettle on them in a small stream

Here is one method of removing ink-spots or other stains from fabric economically

try moistening the material with lemon-juice and hanging it in the sun. If the stain in question is grayish-blue—a huckleberry stain, for instance—a 10 per cent solution of acetic acid should be used, rinsing well afterward.

If plain writing-ink is spilled, soak the stain in a dish of milk. This should remove the stain almost entirely. If not, try a saturated solution of oxalic acid, javelle water, or potassium acid oxalate. Printing-ink stains are loosened by the application of lard and should then be washed out with soap and water.

At every meal you are in danger of grease stains. The first thing to do to a grease stain is to scrape it. Then wash it in soap and warm water. It is often effective to place the material containing stain between sheets of blotting-paper and iron it out.

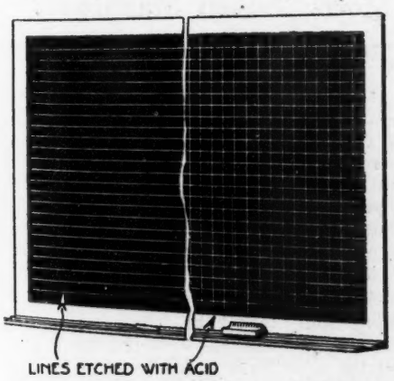
Meat-juice and blood stains should be soaked in cold water; the coloring matter will dissolve quickly, spreading into the water. After this has happened, the stain may be washed in hot water or in ammonia or peroxide of hydrogen solution, and the stain will disappear.

Invisible Lines Etched on Blackboards in Classrooms

INVISIBLE lines etched on the blackboard horizontally and cross sectionally will guide the pupil in keeping on line and aid both pupil and teacher in neat spacing and drawing of curves. The lines are etched by means of acid and are almost entirely invisible from the pupils' seats, but are easily seen by a person standing close to the blackboard.

The most satisfactory way of etching the lines on a slate blackboard is to coat the entire surface with hot paraffin applied with a brush. The lines are then scratched in the paraffin and muriatic acid or other suitable acid is applied over the entire surface. The paraffin will prevent the contact of the acid with the slate except where scratched. The protective coating can then be scraped off.

Lines scratched in with a hard steel point are not as satisfactory as the above, for the white chalk dust fills up the scratches.



Lines etched on the blackboard with acid are visible only to the teacher or pupil standing close to the board

No Slipping on This Kind of Walk

ABOUT to build a concrete walk around my home, it occurred to me that I could use up my old tires.

With a sharp knife I cut them up so that the pieces were about ½ in. square. Instead of laying the concrete in the usual manner, I constructed a wooden mold into which I could pour my concrete and formed a slab 3 ft. square and 3 in. thick. Before filling the mold with the concrete mixture, I covered the bottom of the mold with the pieces of old tire so that the rubber plugs would be imbedded in the surface of the concrete when hard. After pouring the concrete on top of the rubber plugs, I allowed it to set for a week, after which I took the slab out and put it in place on my walk, the side in which the rubber plugs were embedded being the upper.

By the above method my old tires were rendered useful and I had made a walk that was absoulutely non-slippery in wet weather.—RAYMOND FISCHER.

To Light a Safety Match without a Box

Safety matches can be ignited by friction on glass, but, needless to say, the glass is not improved by it

TO light a safety match without its box, it should be rubbed with a long quick sweep on a smooth window-glass. To do this successfully the movement must be a long and rapid one and the match so held between the thumb and fingers that the head will not break off.

The smoothness of the glass prevents the head of the match from rubbing off, as is the case when it is rubbed on a rough surface. The friction of the rapid motion generates enough heat to ignite it.

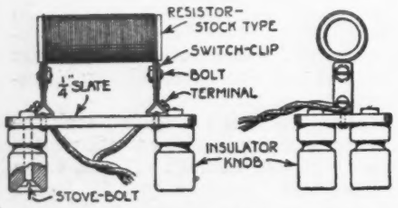
It is not advisable to light matches by rubbing them against mirrors or other highly polished plate-glass; naturally it mars them.

Electric Heaters and Furnaces Built at Home

By H. H. Parker

SEVERAL ways of constructing a small electric heater or furnace for the house, laboratory, or home workshop are described herewith. The best way to obtain a heater coil is to purchase one of those sold as spares for the parabolic copper reflector heaters, or a discarded one may be easily rewound if the core is not broken. Another way is to wind iron or special resistance wire upon a silica tube, which may be bought at a chemical supply house. This is a semi-transparent tube capable of withstanding high temperature.

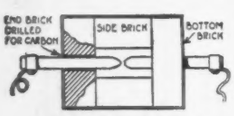
Lacking this, sheet asbestos may be wrapped into a cylinder and pasted together with sodium silicate (waterglass), the liquid often used for preserving eggs.



Here is a stock type of resistor and method of mounting and wiring it

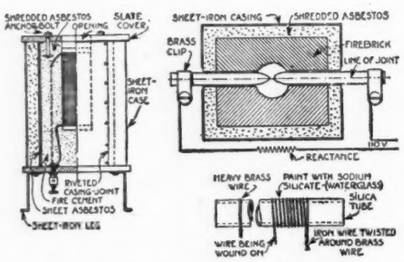
When dry, this tube may be wound, but it is rather poor material for the purpose and probably would not stand up long. After winding any sort of a heating-coil it is a good plan to paint it with sodium silicate, which forms a sort of heat-resistant coating and helps hold the wire turns together.

For general heating purposes, one of these heating coils may be mounted on a block of heat-proof material and supported by four porcelain knob insulators secured to the block with stove-bolts. Two copper clips from an old knife-switch, drilled for small brass clasp-bolts and screwed to the block, form convenient supports for the coil. Sometimes an electric heater is to be used in a drying or baking cabinet and one picture shows how a coil may be clamped in an upright position in such a cabinet so that all the air entering must pass through the red-hot core.

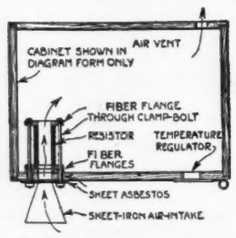


Simple arrangement of a small arc furnace

A heating coil of the type described above, if surrounded by heat-insulating material, can serve as a small furnace to harden and temper light tools, heat chemicals in the laboratory, and for various similar purposes. One way is to cut an ordinary firebrick in half, hollow out the pieces to take the coil, wrap this in asbestos soaked in waterglass and clamp the bricks around it by means of iron straps and tie-bolts, something after the manner in which a large furnace is built. Cavities may be chiseled in the brick to make room for the coil terminals and grooves to lead the wires out to a connection board; then all remaining spaces or cracks are caulked with asbestos. As there will be little heat radiation through such a furnace, the coil might overheat and burn out and it would be well to try it out in series with a small resistance coil, made of a few feet of iron or resistance wire, until it is determined how much current the coil will stand.



Details of a more complicated arc furnace and of a resistance furnace

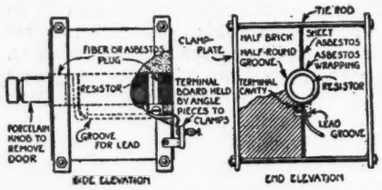


This is a diagram of a resistor-heated cabinet

Furnaces of this character, but vertical, with the upper end open, are widely used in laboratory work to take the place of the Bunsen burner. The firebrick furnace, stood on end, could be used in this way, but one of a slightly different construction is shown. This is made by surrounding the coil with fire clay or special fire cement, various makes of which are on the market, tamped into a sheet asbestos cylinder. Then a sheet-iron case is made, about an inch larger in diameter than the asbestos cylinder, and the space filled with shredded asbestos made into a paste. Such a construction adds considerably to the efficiency of a small furnace. Before applying the current, the whole assembly must be carefully dried out in an oven.

A small horizontal furnace may be built in this way also. In this type, both center openings, if not in use, are closed by built-up asbestos plugs. In the vertical furnace, a top and bottom circular cover of transite, with anchor bolts and sheet-iron legs, are shown.

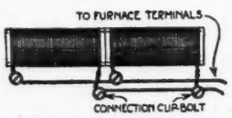
Arc furnaces have been too often described to require repetition here, though two of these are shown. One is built of two pieces of firebrick, grooved for the insertion of the carbons, with an outer heat insulating layer of asbestos and sheet-iron cover, similar to the construction described above.



Showing details of a tubular resistance furnace with front and side elevations

Due to the much higher temperature of the arc, careful heat insulation is of considerably greater importance than in the case of the resistor furnace.

Another simpler arc furnace is shown, built up of firebrick blocks, one each for top and bottom and four forming the heating compartment of the furnace. Two of these are drilled to allow insertion of the carbons. Such a furnace is of low efficiency but quickly and easily built. Unless a transformer of the magnetic leakage type is used, resistance must always be used in series with an arc when run off a regular lighting circuit; this may be a water rheostat or a few feet of iron wire of about No. 24 gage, wound into a coil.



Resistor used in series with arc furnace

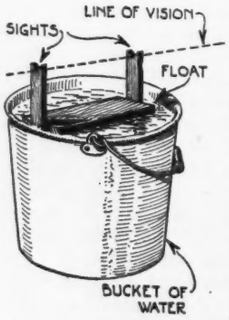
Improvise a Hydrostatic Level for Rough Work

IF you have to level the ground in your garden or on your farm, or lay out ditches for drainage, you need a leveling instrument of some kind. Such instruments, even of the simplest type, are costly, far too much so for the average gardener or farmer who uses them only on rare occasions.

By following with care the directions here given, a level may be improvised that will give satisfactory service in all cases in which extreme correctness is not essential. The device consists of a square-cut piece of board, 1 in. thick, 8 or 10 in. long, and about 3 in. wide, to the ends of which narrow strips of wood, about 3 or 4 in. long are nailed at right angles.

The side strips should be of the same length and each should have a notch for sighting, as shown in the illustration.

If the board is placed in a bucket of water and is allowed to float on the surface without touching the sides of the bucket, a line drawn through the two upright sights will be horizontal, provided the work has been done with proper care. To make sure that the level is accurate, it should be tested before it is put to practical use.—RUSSELL CRING.

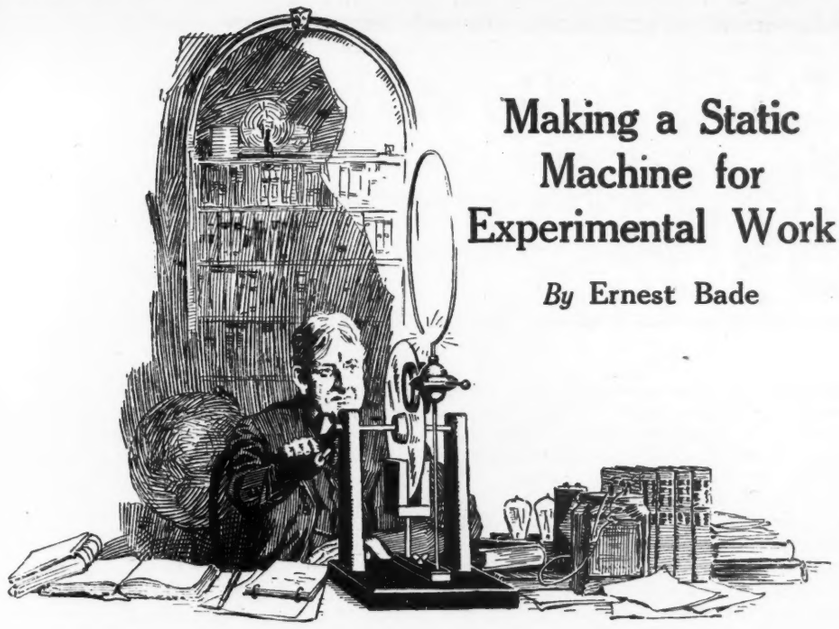


For rough work this level is sufficiently accurate

Do You Number Your Motor-Driven Machines?

NUMBER stencils and a pot of white paint will save a lot of confusion in a shop operating motor-driven machines. A large white number painted on the machine and the same number on the switchbox on the wall of the shop will tell the workmen what is what without there being need for guessing.

Often the starting-boxes of several machines are placed close together on the wall with nothing to indicate which machine each box controls. If the driving motor is not direct-connected, but operates through a countershaft, the machine number painted on the motor as well as on the starting-box is helpful for avoiding confusion.—F. M. WESTON, JR.

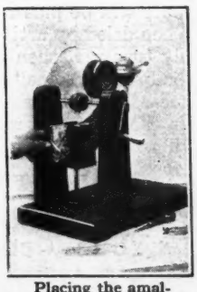


Making a Static Machine for Experimental Work

By Ernest Bade

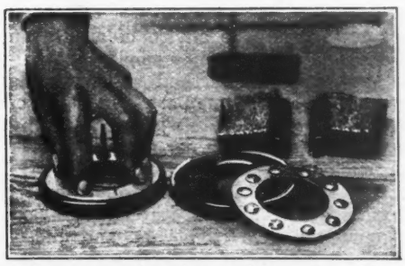
ABOUT 1800, Professor Volta, of Paris, experimented with a substance known as the "vital fluid," a name given to electricity by Galvani, professor of anatomy, at Bologna, Italy, in 1790, who found to his surprise, while accidentally touching the hind legs of some frogs that hung on a copper hook with an iron nail, that they were drawn up with a singular convulsive movement. But Volta soon laid aside Galvani's theory, for he found that the contact of two dissimilar metals caused the effect in question. For example, if a piece of zinc is placed under the tongue and a silver coin is placed on the tongue at the tip a thrilling sensation is felt; but if the two metals above and below the tongue do not touch each other, nothing is perceived. This is the principle of Volta's pile, which consists of a number of circular plates of copper and zinc arranged in pairs and between each pair a piece of cloth moistened with a weak acid or a saline solution is placed. The whole is insulated with glass and the top zinc plate and the bottom copper plate are connected with wires. This arrangement gives small sparks, the intensity varying with the number of pairs of metal used.

Voltaic electricity and that developed by friction are of the same kind, but are characterized by certain points of differences. First, the electricity developed by friction is far more intense; and that produced by chemical action is far greater in quantity. Second, voltaic electricity will not pass through an insulating material, as the electric spark does. If the circuit is broken, all action ceases at once. It will pass through thousands of miles of conducting wire, but will not leap a break 1/50 in. in length. Third, the chemical effects of voltaic electricity are incomparably greater than those of frictional electricity. The galvanic battery produces the most intense heat, and readily decomposes substances. No such effects belong to the static machine. An ordinary battery will decompose a grain of water into oxygen and hydrogen. To do this with frictional electricity would require the power of an electrical plate having a surface of 32 acres —this would be equivalent to a flash of lightning.



Placing the amalgam pads

The plate-glass disk is put on



Putting together the circular combs with their thumbtack teeth

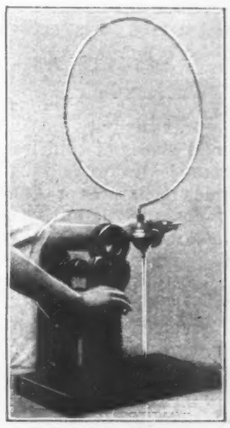
A static machine capable of producing a 3-in. spark can easily be made. It consists of a circular plate 12 in. in diameter, an amalgam covered "rubber," a spherical conductor, and a hardwood base. The exactness with which the various parts are made and put together greatly influences the capacity of the machine. If the parts are carelessly made, very little electricity will be generated, but a machine carefully made will give sparks of much greater intensity than was expected. On very dry weather such a static machine will give a spark from 5 to 6 in. in length. But sparks of such length will be attained only by machines of perfect workmanship made with suitable material.

The heavy base and the two supporting arms are made from hard wood, preferably mahogany. The base is 20 in. long by 12 in. wide, and the two arms are 16 in. long. The latter carry the axle of the revolving plate. Two U-shaped pieces of wood, 4 by 2 by ½ in., are also made. These are later screwed to the base with winged bolts.

Next the glass plate with its glass axle is procured. This is the most expensive part of the entire machine, for it is best to buy one direct from an electrical supply house instead of going to some glass-cutter, where one is apt to get a plate unsuited for electrical purposes.

The "rubber" consists of two thick pieces of felt covered with an amalgam of two parts of mercury, one part of tin, and one part of zinc. This is evenly distributed in a thin layer with the aid of a little lard or other fat which helps to hold this metal to the felt. These two rubbers are placed in a frame supported by a glass rod 4 in. in length and held in place by one of the U-shaped pieces of wood.

The conductor consists of a large hollow brass ball attached to a glass rod which is held erect by the other U-shaped piece of wood. A brass bar is passed horizontally through the sphere, one end receives a small brass ball and the other a circular metal comb of tin. The teeth, which can be made of thumbtacks, must not touch the plate, but they should be about ⅛ to 1/16 of an inch from the plate.



Appearance of the completed machine

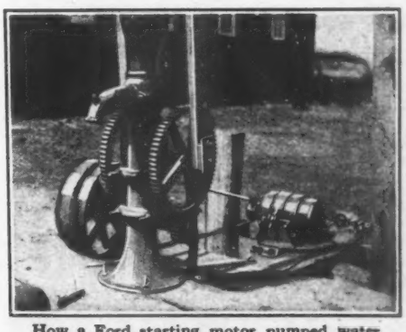
A flap of silk is now glued to the rubber. This prevents a loss of electricity. The capacity of the conductor can be heightened by placing an iron ring, whose ends must not touch, on the hollow sphere. This iron ring should be well insulated with a wooden jacket (a heavy coating of paper strips can be substituted).

If the handle of the machine is now turned toward the combs, static electricity will be developed.

This Ford Starting Motor Pumps Water

I HAVE made use of an old Ford starting motor by attaching it to a 32-volt lighting plant and I use it for pumping water at the well in place of a gasoline engine. I use it for pumping water for about 100 head of stock and it proves to be very effective.

The motor is bolted to a plank 2 ft. long and fastened to the well platform. This



How a Ford starting motor pumped water for a big herd of cattle on a stock-farm

forms a firm foundation for the motor. The switch I have placed about 3 ft. from the ground, on a 4 by 4 in. post to which the wires are attached. The belt is made of an old harness tug.—MARION O. SWENSON.

Useful Things to Do at Home

Hints that will help you in doing odd jobs around the house, saving time, temper, and money

Don't Throw Away Any Screen-Wire Scraps

AROUND the home or workshop one occasionally has need of some very small pieces of thin iron or steel wire, for instance, to wrap the threads of a bolt, which from wear or other cause has become too loose in the nut. One or two layers of small wire—wrapped tightly in the bottom of the thread groove—are sufficient, in most cases, to tighten the nut and prevent its working loose.

For such a small job one does not care to buy a whole spool of thin wire, nor is it necessary if a scrap of wire screen is available. By starting at the edge, where the screen wire has been cut, it is an easy matter to pull out as many lengths as desired. Being a tough steel wire, it is not only adapted for the purpose mentioned, but it will also be found useful for many other small jobs, such as holding small pieces to be soldered, mending toys, etc.

Since these pieces of screen wire soon become misplaced, or rusty, several strands should be pulled from the mesh and wrapped on an empty thread-spool and the whole wrapped in an oiled paper or cloth. This will serve the double purpose of preventing the wire from rusting and from getting tangled.

Preserving Varnish Brushes for Future Use

THE man who regularly varnishes his floors will not want to invest in new brushes each season when the time comes to touch up his floors. Varnish brushes should never be put into water. They should be suspended in corked jars of linseed oil. The method of suspension is to bore a small hole in the center of the cork and wedge the end of the brush into this hole.

Warped Stove-Plates Are Easily Straightened

WHEN the cross members between stove lids are bent downward from long use, they may be straightened in the following manner. Turn all the round lids and the cross members over; putting them back in their accustomed places bottom upward. Place some heavy iron weights on the bent pieces—so that the weight comes on the highest part of the bend. Next, build a hot fire in the stove. The fire must be hot enough to bring the cross members to a warm red heat. If the warped pieces do not begin to straighten, *i. e.*, to bend downward, within ten or fifteen minutes, add more weights. But be careful! Remember that you can not bend hot casting by blows; it will break. Therefore, do not allow a weight to fall either on the cross members or on the weights that have previously been placed on them. If the weights are still insufficient, sprinkle a little water on the highest parts of the bent pieces. Use *very little* water; it is better not to use any. Get more weights if possible.

As soon as the bent pieces are *almost* straight, either draw the fire or smother it. Do not throw water into the stove. Allow the stove to cool, remove the weights, and turn over the lids and cross members; you will be agreeably surprised to find that the top of the stove is almost as level as when new.

Disinfecting Books without Injuring Them

DURING the prevalence of epidemics it is a wise precaution to disinfect all books obtained from a public library before using them.

According to the advice of an Italian scientist, books may be completely sterilized by a simple method without being injured. Dissolve one part, by weight, of calcium chloride crystals in two parts, by weight, of a 35 to 40 per cent solution of formaldehyde. The syruplike liquid obtained will keep its effectiveness several months.

Place the books on a grating of galvanized iron in an airtight box and underneath the grating stretch a cloth previously dipped in the solution and well wrung out. Close the box and leave the books in it for twenty-four hours.

Use Copper Wire when You Hang Pictures

EXPERTS have made many tests recently to determine which kind of wire will give the safest and most lasting support for the suspension of paintings in art galleries or homes.

It was found that copper wire, plain, and in a single strand, is far superior to twisted or braided cords of thin iron or brass wires, and has the additional advantage of being rust-proof.

Kerosene Has Many Uses in the Household

KEROSENE is one of the most useful items on the list of indispensable household articles. A bottle or can of it should be in every home. Its usefulness as a fuel is well known to every owner of an oilstove. Housewives may know that kerosene has valuable cleansing properties and that one or two teaspoonfuls of it in the water in which the soiled clothes are soaked before washing, will materially aid in the cleansing. But there are also many other useful purposes for which kerosene may be employed by the handy man.

If your bathtub, your wash-bowl, the tiles on the walls of the bathroom, or any other enameled surface requires a thorough cleansing, dip a rag or a sponge in kerosene and wash the soiled surfaces liberally with the oil, using a moderate pressure in rubbing. Allow the kerosene to remain five or ten minutes and then wash the surface with a soft rag and plenty of hot water.

Kerosene, applied with a soft chamois skin or a pad of absorbent cotton, will cleanse and restore the luster of polished piano panels that have become "blind." The odor of kerosene may be objectionable, but the oil evaporates rapidly and with it the odor vanishes. Polishing the restored surfaces with a soft silk rag after the oil has been wiped off, will increase the luster. Hard rubbing should be carefully avoided, because it invariably leaves streaks.

For removing greasy or oily dirt and fingermarks from pottery, glass, or the painted and varnished surfaces of doors, furniture, etc., there is nothing better than kerosene, applied with a soft chamois skin and then wiped dry and polished with a silken rag.

How to Foretell the Weather without a Barometer

FROM thin white blotting-paper or any other white and absorbent tissue a reliable hygrometer may be made which will indicate the amount of moisture in the atmosphere and enable you to forecast the weather in a limited measure. Dissolve 1 part of chloride of cobalt and 10 parts of gelatine in 100 parts of water and soak the paper or other tissue in that solution. The paper will be pale rose red while it is wet. When dried by artificial heat it will gradually turn red, then bluish red, then lavender blue and finally a beautiful sky blue. According to the amount of moisture in the air the color of the paper or other tissue will vary between rose and blue.

Always Keep Charcoal In Your Medicine-Chest

THE medicine closet of every household should contain a well stoppered bottle with finely pulverized fresh charcoal. Dr. Secheyron, one of the professors of the university of Toulouse, France, has ascertained by a series of tests that charcoal is one of the most efficacious antidotes against nearly all kinds of poison. Even in cases of poisoning by quickly acting poisons, such as strychnine and toadstools, serious consequences were averted by giving to the patient at intervals of ten minutes liberal doses of charcoal suspended in water. Water and finely pulverized charcoal are placed in a bottle and violently shaken before a dose of the mixture is given to the patient.

DETROIT

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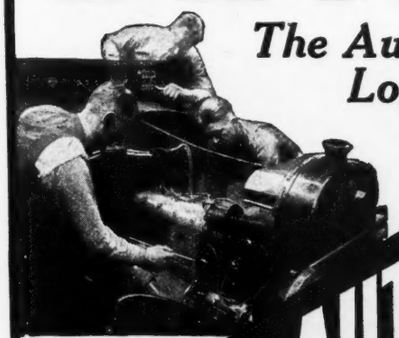
Training for Head and Hand

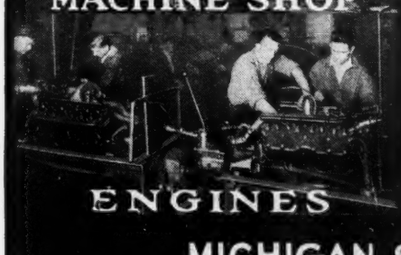


RADIATORS

BATTERIES

TRACTORS

MACHINE SHOP



ENGINES

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New Prize Contest

"How I Made Money with My Tools"

HAVE you ever made extra money with your tools? If you have, we want to know just how you did the trick. If you constructed something, describe it. If there is a particular job that you do, let us know what it is. For instance, we have heard of a chap who mends furniture in his neighborhood during his spare time. Others have established small spare-time businesses with tools as their only investment.

Sit down now and describe your own experience for the readers of Popular Science Monthly. If you have photographs or drawings of the things you have made or the job you do, send them along.

Tell your story as humanly and interestingly as possible.

$90 in Prizes

Popular Science Monthly intends to make this worth your time. If you do not win one of the three big prizes it is possible that your article will be bought at space rates. First Prize will be $50; Second Prize, $25; and Third Prize $15.

Conditions of the Contest

(1) Contestants are not limited in the number of ideas. The contest is open to everybody.

(2) If a drawing is sent in, it need not be made by a skilled draftsman. The contestant's name and address should appear on each sheet of drawings.

(3) Drawings and photographs must be accompanied by a description, preferably typewritten, in which the subject is clearly explained. The MSS. must be written on one side of the paper only, and should not be more than 500 words in length.

(4) Drawings and descriptions entered by contestants must be received by Popular Science Monthly not later than 5 p. m., on January 20, 1922.

(5) The judges of the contest will be the editors of Popular Science Monthly.

(6) The first prize of $50 will be awarded to the contestant who, in the opinion of the judges, has suggested the best idea.

The second prize of $25 will be paid to the contestant who submits an idea next in merit.

The third prize of $15 will be paid to the contestant who submits an idea third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of Popular Science Monthly, and their articles will appear later.

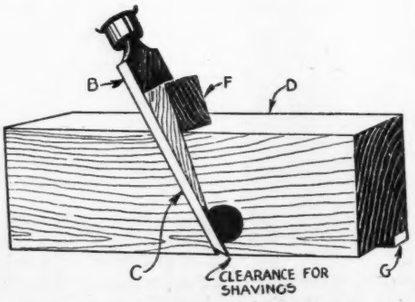
(8) The editors of Popular Science Monthly shall have the right to publish meritorious manuscripts that do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(9) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

(10) Send drawings and specifications to the Editor of the Making Money with Tools Contest, Popular Science Monthly, 225 West 39th Street, New York City.

This Rabbet-Plane May Be Improvised

TO make an impromptu rabbet-plane, cut a block of hard wood to the size of about 9 in. by 3½ in. by 1¼ in., and with a brace and bit bore a hole ¾ in. in diameter, not more than 1 in. deep through it, as shown in the illustration. Then, with a tenon-saw, cut a wedge-shaped slot of the same depth. The depth will depend upon the width of the chisel you are going to use, as will the thickness of the slot on the thickness of the chisel.



From a chisel and a block of wood this rabbet-plane can easily and quickly be improvised

Make a hardwood wedge, place the chisel in the slot and wedge it tight. A slip of wood may be glued on the face of the plane for a guide so that it may be used as a fillister.—E. A. McCann.

Keep the Rooster's Comb in Prize Condition

ROOSTERS with abnormally large combs are sometimes very valuable. But this value is considerably diminished when the combs lean to one side or hang downward, giving even the best-appearing fowl a forlorn appearance.

How a prize rooster's comb is trained

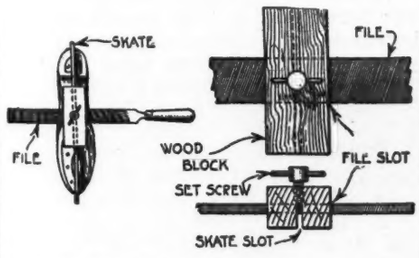
Such roosters cannot be placed on exhibition with any degree of success unless this drooping comb is raised. In order to do this, some kind of a holder must be attached to the comb that will keep it in an upright position. The easiest way to overcome the difficulty is to make a light but strong wire support. This is bent as near as possible to the shape of the comb, and when two such wires have been bent, they are placed on each side of the comb and fastened together with strong thread or thin cord.

A comb treated in this way for a short time will often be permanently straightened.—E. BADE.

Get Your Skates Ready for the Winter

THE little device for sharpening skates shown in the illustration is made from a block of wood about 1½ in. square by 3½ in. long. The oblong hole in the side is cut with a ¼-in. bit by boring four holes close together and then cutting them through with a knife or chisel and filing smooth with a rasp.

The rut in the bottom can be made with a saw and should be a trifle wider than the runner of the skate and also reach the bottom of the oblong hole.



By following the directions given below, you may sharpen the runners of your skates at home

Bore a ⅛-in. hole in the center of the top for a thumbscrew, which will keep the file in place. The thumbscrew should fit snugly in the hole so it can be tightened and loosened by turning it.

Slip a file through the oblong hole, tighten the thumbscrew and it is ready for use.

It is used by slipping the runner of the skate into the groove and drawing it back and forth until the desired edge is obtained.—WALTER S. J. THOMPSON.

Try This Way

See how your teeth look then

Here is a new way of teeth cleaning—a modern, scientific way. Authorities approve it. Leading dentists everywhere advise it.

Ask for this ten-day test. Watch the results of it. See for yourself what it means to your teeth—what it means in your home.

The film problem

Film has been the great tooth problem. A viscous film clings to your teeth, enters crevices and stays. Old ways of brushing do not effectively combat it. So millions of teeth are dimmed and ruined by it.

Film absorbs stains, making the teeth look dingy. It is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Germs breed in it. They, with tartar, are the chief cause of pyorrhea. Thus most tooth troubles are now traced to film.

Combat it daily

Dental science has now found ways to daily combat that film. Careful tests have amply proved them. They are now embodied, with other most important factors, in a dentifrice called Pepsodent.

Millions of people now use this tooth paste, largely by dental advice. A 10-Day Tube is now sent free to everyone who asks.

Its five effects

Pepsodent combats the film in two effective ways. It highly polishes the teeth, so film less easily adheres.

It stimulates the salivary flow—Nature's great tooth-protecting agent. It multiplies the starch digestant in the saliva, to digest starch deposits that cling. It multiplies the alkalinity of the saliva, to neutralize the acids which cause tooth decay.

Modern authorities deem these effects essential. Every use of Pepsodent brings them all.

See the results

Send the coupon for a 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how teeth whiten as the film-coats disappear. Watch the other good effects.

This test, we believe, will bring to your home a new era in teeth cleaning. And benefits you never had before. Mail coupon now.

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The Home Workshop Department Offers $75 in Prizes Each Month for the Best New Ideas

A FIRST prize of $50 and a second prize of $25 will be awarded every month to the authors of the two best articles appearing in this department. Every article submitted will be considered as a possible prize-winner. Those which do not win prizes may be purchased at space rates. The prizes will be awarded upon publication and checks will be mailed to the winners during the same month.

Prize-winning articles may be long—but not over 1000 words—or they may be very short. The idea, device, or machine described must be practical and ingenious; it must fill an actual need in the home, office, or shop.

This contest must not be confused with other contests which Popular Science Monthly is conducting at the same time.

Prize-Winners for November

The two prizes of $50 and $25 for the "Best Ideas" appearing in the November issue of Popular Science Monthly have been awarded respectively to F. E. Brimmer, of Cazenovia, New York, and E. G. Gettins, of Los Angeles. These two ideas were considered by the judges to possess the highest all-round merit of those submitted.

It should be remembered that this "Best Idea" contest is a monthly feature. You may have an idea that will win the prize next month. Read the rules above.

One Way to Help Relieve the Paper Famine

By F. E. Brimmer

(Awarded First Prize in "Best Idea" Contest for November)

IF all the available pulp lumber in the United States were cut to-morrow, it would supply our demand for white paper just about one year. So estimates the New York State Forestry College.

If everybody would save his waste paper, it would save one billion feet of this lumber each year. A paper famine confronts us. The way to help is to save your paper scraps. Books, magazines, newspapers, waste-paper debris, cardboard, everything made from paper should be saved and sold where it will go into the raw paper market.

Your waste paper will be used to make roofing and building paper, packing-boxes, and shipping containers.

Magazines and books that are past their day of usefulness may be tied in bundles. Your waste paper, newspapers, etc., should be baled and this waste paper will bring from half a cent to a cent a pound and most likely more as the paper shortage increases.

One does not need to buy a pressing machine to bale his waste paper. Such a machine may be made in a short time from a well-built wooden box. The one illustrated was made from a box that was 15 in. square at the ends on inside measurements by 2 ft. long. The side and end were removed and secured back in place by means of hinges.

It is necessary to have the side and end movable so that the well-compressed bale may be readily removed. The three unfastened corners of the box were secured by means of three catches or old hinges when the paper was being pressed down.

To use this press more conveniently, it was found best to nail several upright boards about the sides that would steer the loose paper into the box as it was dumped from the waste-baskets. The cover was made from 1-in. boards 6 in. wide, held together by three cleats, and the top was of the same dimensions as the inside of the box into which it fits.

Build a paper-press like this and do your share toward mitigating the existing paper famine

Three medium heavy cords are placed in the empty box in the position for tying, one lengthwise and the two others crosswise of the bale. Then the paper is dumped in and pressed down by a beam resting on the cover.

A few bricks is all you will need as a fulcrum for the lever, which should be 2 by 4 in. and 8 ft. long. A bale of paper that weighs 50 lbs. may be pressed in this box without any difficulty whatever to the operator.

THE HOME WORKSHOP

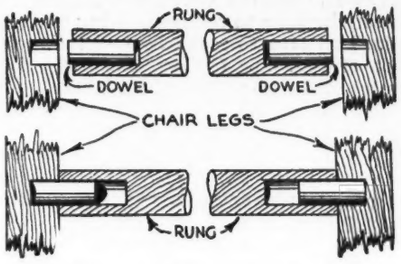
How to Fix the Broken Rung of a Chair

By E. G. Gettins

Awarded Second Prize in "Best Idea" Contest for November

FIXING a broken rung in a chair, or putting in a new one without taking the whole chair apart, is not such an easy job as it appears. The accompanying sketch shows how it can be done with very little trouble.

Sometimes the rung will break off even with the chair leg on one side; in that case saw it off close to the leg at the unbroken end. Then drill a hole into both ends of the rung large enough to hold a ¾-in. dowel, about 1⅜ in. deep, and then drill into the legs a hole of the same diameter, about ½ in. deep. This hole is drilled right



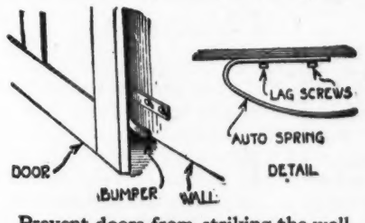
This shows how you may mend a broken rung without taking the chair to pieces

into the broken dowel or tenon of the original joint. Cut two pieces of ⅜-in. dowel, 1½ in. long; smear them well with glue and push them into the holes in the end of the rung. This will leave them projecting about ⅛ in. at each end. Spread the legs a bit and allow them to close up on the rung. The dowels will then just be entering the holes in the legs.

Now take a thin flat knife, and spreading the legs slightly, press the knife into the dowel, close to the shoulder of the rung and move the dowel by means of the knife into the leg as far as the space will permit. Repeat this until the dowel will not move any farther, and do likewise with the other side. The dowels will now be in the right position as shown in the picture. Tie up the legs tightly with a rope while the glue is drying.

Make a Door-Bumper from an Auto Spring

TO prevent doors from striking the wall, breaking the glass, or doing damage to stucco, brick, or woodwork, make a bumper from an old auto spring, heated



Prevent doors from striking the wall by an automobile-spring bumper

and cut in the center. Punch two ½-in. holes near the heavy end while hot, and bend to form as shown.

Fasten the spring near the bottom of the door with 2 lag screws so that the door will come in contact with the spring before hitting the wall.—R. W. JAMISON.

Vigilance

THE VALUE TO THE PUBLIC of the Bell System service is based on the reliability, promptness and accuracy of that service.

As quality of service depends upon the economic operation of all telephone activities, vigilance begins where work begins. Science and engineering skill enter into the selection of all raw materials; and into the adapting and combining of these materials to the end that the finished product may be most efficient in operation and endurance, and produced at the least cost.

A series of progressive tests are made at every step during the transformation of these materials into telephone plant and equipment. And when all these complicated devices, with their tens of thousands of delicately constructed parts, are set in operation they are still subjected to continuous, exhaustive tests.

As the best of materials and the most complete machinery is of little value without correct operation, the same ceaseless vigilance is given to the character of service rendered in providing telephone communication for the public.

Such constant vigilance in regard to every detail of telephone activity was instrumental in upholding standards during the trials of reconstruction. And this same vigilance has had much to do with returning the telephone to the high standard of service it is now offering the public.

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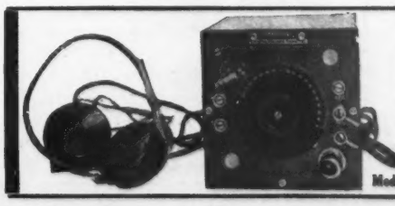

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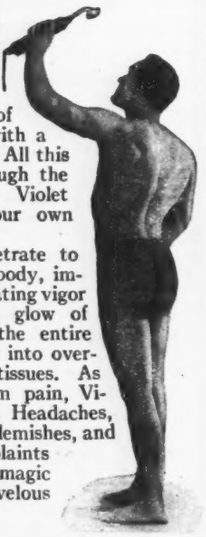

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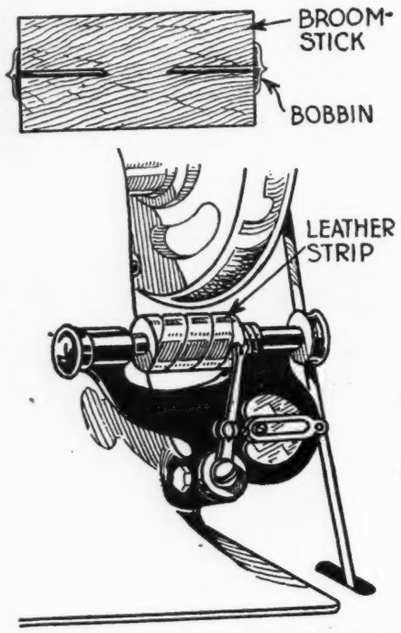
Safety-Razor Sharpener Run by Foot-Power

FROM a small piece of broom-handle with the ends of a regular sewing-machine bobbin driven into its ends and some soft leather (such as tops of old shoes) wrapped spirally around it, a good stropper for safety-razor blades may be made. It is placed in the bobbin-winding attachment, and the sewing-machine operated just as though you were winding bobbins. A little razor-strop dressing should be put on the leather and worked in well.

Before putting the leather on the wood, put the cylinder in the attachment and run it at top speed, while holding sandpaper against it, so as to get it to run true.



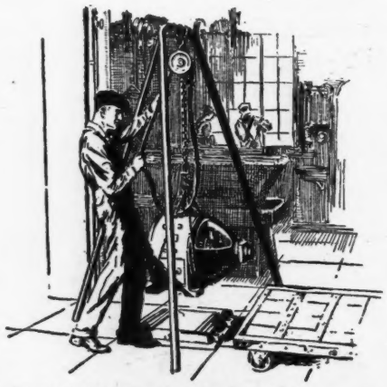
The belt that drives your sewing machine will operate this safety-razor sharpener

Portable Crane for Use in Yard or Shop

PRACTICALLY one of the simplest types of portable cranes that can be rigged up for use about the shop or shop-yard consists of a tripod support.

The material used in this construction consists only of three lengths of wrought-iron pipe threaded at one end and screwed into a pipe T. The pipe is bent after being screwed solidly into place to bring the props about 4 or 5 ft. apart at the base.

With a block and tackle or small chain hoist lashed to the pipe T, this portable crane is readily lifted about from place to place.—G. A. LUERS.



Portable tripod cranes are suitable for a small shop because they can be folded up

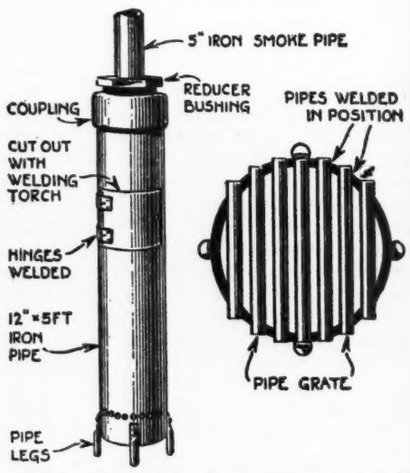
An Efficient Shop Stove of Pipe and Fitting

THIS space-saving stove will give enough heat to warm a fairly large shop, and the only tools needed are such as are found around any machine-shop.

Most of the work is done with the welding-torch and a drill. The materials necessary are one piece of 12 in. or 14 in. iron pipe 5 ft. long; one coupling to fit; one reducing bushing to reduce to 5 in.; enough 5-in. iron pipe to reach beyond the roof; 2 ft. of 1-in. pipe for legs, small pipe for grates, and a pair of 3-in. butt-hinges.

The legs are 6 in. long and are flattened at one end and welded in place. The door is cut with the torch, and the hinges welded in place. After the holes are drilled for the grate-bars, the bars are also welded to keep them from slipping out.

When the stove is in operation, the top becomes red hot and gives out plenty of heat. The combustion of the fuel is so nearly perfect that very little smoke comes from the chimney.—CHARLES N. SHAW, JR.



This stove occupies a very small space, but will supply a considerable amount of heat

Making Blotter-Pads from Old Magazines

OLD magazines, newspapers, and books of all kinds are readily transformed into blotting-pads by boiling them in water with a handful of soda.

Any old tin of suitable size may be used for the purpose. Begin by putting in the magazines as they are—binding and all—and cover them well with water before throwing in the soda. Let them boil until about half the water evaporates.

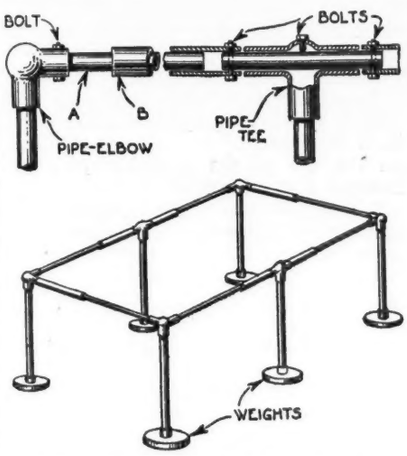
It is best to lay the old magazines upright in the tin so that the soda more easily removes the "size" and renders each page absorbent. Allow the paper to dry thoroughly, and you have a blotter-pad that will last indefinitely.

THE HOME WORKSHOP

To Make an Adjustable Pipe Railing

WHENEVER a ditch is dug in the streets, the contractor usually builds a temporary wooden railing to prevent any one from falling in.

One contractor improvised from pipes and standard fittings a barrier that was more easily set up and moved than the old wooden fence. The adjustable railing shown in the illustration is made from two



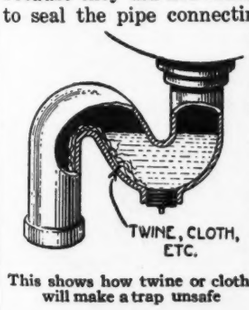
Pipes, fittings, and a few weights for bases are the material from which this railing is made

different sizes of pipe and standard pipe fittings. The small pipe slides into the larger pipe. Both are fastened with bolts and nuts to the fittings. The lower ends of the upright pipes are weighted to form a strong structure. By moving these weights closer or farther apart, the railing can be made longer or shorter, wider or narrower, as needed. The length can also be changed by using more or fewer extensions.

When the railing is not in use, it can be easily dismantled and shipped in compact form to another job.—FRANK HARAZIM.

How Sewer-Gas May Get into Your House

SEWER-GAS sometimes escapes into dwellings through well constructed traps which, normally, offer complete protection from that danger. In nearly every case it was found that the traps did not function because they did not contain enough water to seal the pipe connecting the trap with the sewer against the invasion of the poisonous gas.



This shows how twine or cloth will make a trap unsafe

This was caused by accumulations of threads, strings, and strips of cloth in the trap in the position shown in the illustration. The strings and pieces of cloth absorbed the water in the bowl by capillary action and, acting as a siphon, soon reduced the level of the water below the lower edge of the gas-curtain of the trap.

In view of the danger which may result from such accumulations, it is well to examine each trap frequently and to remove all waste with a flexible wire.

Trade Mark
HANES
ELASTIC KNIT
UNDERWEAR

Hanes 5 Big Features

1 Hanes Staunch Elastic Shoulders made with service-doubling lap seam. They give for every motion.
2 Hanes Tailored Collarette won't gap or roll. Fits snugly always.
3 Hanes Elastic Cuffs are made far stronger and better than the usual cuff. They won't flare or rip.
4 Hanes Closed Crotch is cut and stitched a special way that really keeps it closed.
5 Hanes Elastic Ankles hold their shape through repeated washing. They don't bunch over the tops of your shoes.

Hanes Guarantee

We guarantee Hanes Underwear absolutely—every thread, stitch and button. We guarantee to return your money or give you a new garment if any seam breaks.

You'll Get Top Comfort and Bottom Prices in
Hanes Winter Underwear

You'll be mighty thankful for Hanes Winter Underwear when you have to shiver out of the sheets, those nippy mornings this winter. But when you pull that warm, cottony fabric up around your legs, it will thaw the chills right out of you.

And right now you can get Hanes Winter Underwear at a tremendous reduction in price. There's a big drop in the Hanes prices this year. Hanes is so full of comfort, durability and service that it stands head and shoulders above any underwear at anywhere near its price.

Look at those wear-giving features listed in the illustration. Realize that the fine quality buttons are put on to stay, and that the buttonholes hold their shape and won't break. Hanes value is in a class by itself.

See Hanes Winter Underwear at your dealer's. It includes warm, sturdy, heavyweight union suits, and shirts and drawers as well as a mediumweight, silk-trimmed union suit.

Hanes for Boys—If you're the parent of a healthy, lively boy, you'll give him the cold weather protection he needs by fitting him out with Hanes Boys' Union Suits. Made in sizes from 2 to 16 years. Two to four year sizes have drop seat.

If your dealer can't supply you with Hanes, write us immediately.

P. H. HANES KNITTING CO., Winston-Salem, N. C.

Next Summer—You'll want to wear Hanes Nainsook Union Suits!

WIRELESS FOR EVERYBODY
The Little Wonder Portable Radio Set

that you saw in the "movies," the daily papers, etc. Simple to install and operate. Just the thing for Boy Scouts, Campers and for use on bicycles, etc. Complete in every respect and guaranteed to give complete satisfaction. Just connect your aerial ground and phones and you are ready to receive messages. Tunes to 800 meters and receives telegraph messages within 1,000 mile radius and wireless telephone messages within 30 mile radius.

Type S8 (as illustrated), price $7.50
Type S8A complete (incl. phone, aerial, insulators and instruction book) $12.50

Radio Service Apparatus may be obtained at all reliable dealers or sent direct to you on receipt of price

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Sales Office: 110 W. 40th St., Suite 1002, New York City
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Manufacturers of Complete Line of Radio Apparatus

Sloan's Always Relieves Your Rheumatism

Sloan's has been the old standby for all sorts of external aches and pains resulting from weather exposure, rheumatism, neuralgia, sprains and strains, lame back and over-worked muscles. Penetrates without rubbing.

At all druggists, 35c, 70c, $1.40

Keep it handy

Sloan's Liniment (Pain's enemy)

Burglars Don't Seek The Limelight

DARKNESS is their stock in trade. They work by stealth—unheard and unseen—their movements cloaked in secrecy. It's honest folks that seek the light. They are the only ones who can risk it.

It's the same way in business. The manufacturer who is not sure of his goods does not dare to advertise. Advertising would hasten the end of his business career—put him to a test he could not meet.

The manufacturer who advertises, deliberately invites your inspection. He tells you about his product and then lets it stand on its own merits. You can depend on him. *He knows his product is good.*

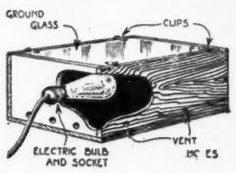
That's one reason why it pays you to read the advertisements. It is through advertising that you are able to keep in touch with the good things that progressive business men are spending their money to introduce and to keep before you.

Advertisements are interesting, instructive and profitable. They throw a powerful light on the very things that concern you most. Read them.

THE HOME WORKSHOP

Device for Locating Splinters in the Hand

THE box shown will make a good addition to any safety-first equipment. A strong electric light is placed inside a box after the inside has been painted white to obtain maximum reflection. A hole is drilled in the box into which an electric-light socket is forced. A number of holes are also placed around the box to prevent the interior from getting too hot.

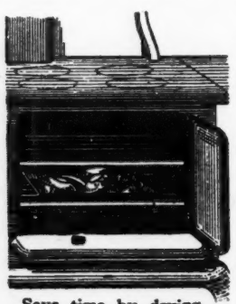


Splinters are quickly located with this device

If a hand with a splinter in it is placed on the top of the ground glass that is fastened to the top with brads, the splinter will be noticed at once, as the hand will be semi-transparent under the action of the powerful light.—J. B. MORAN.

Save Time by Drying Dishes with Heat

AFTER the dishes are washed, place them on a tray and put it into the oven. Use a small flame to give a moderate heat. In a few minutes the dishes will be dried by the heat. Extinguish the flame and allow the dishes to cool. This saves the trouble of wiping the dishes and is more sanitary and effective. The cost of the gas is far less than for laundering dish-towels.—B. FOX.

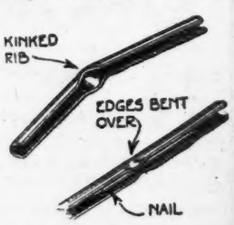

Save time by drying your dishes in the oven

Straighten Bent Umbrella Ribs without Breaking Them

WHEN a rib of an umbrella is bent, any attempt to straighten it usually results in a broken rib and a ruined umbrella.

I fixed one some time ago and it seems stronger than when new.

Straighten the kink with the hands as much as possible, using pliers lightly so as not to dent it at another place. Take a fourpenny nail, cut the head off, and with the hammer lightly tap it into the groove of the rib. This will straighten out the sides of the rib.



How bent umbrella ribs are straightened

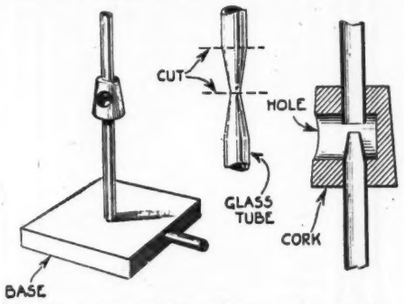
Now bend the sides over just enough to keep the nail from slipping out. This can best be done with the pliers, but light taps with the hammer will also do it. The sides need not be bent over the full length of the nail; just in the middle, and the ends of the nail keep the rib straight.

An Efficient Homemade Bunsen Burner

YOU may make a neat and practical Bunsen burner for home use or the laboratory in the manner here described.

Heat a glass tube about 3/16 in. in diameter, draw it to shape, as shown in the picture, and cut off with the edge of a file at the two points indicated.

Through a cork or rubber stopper bore or burn a hole so it will fit tight around the tube. Then cut a hole through the side to the center of cork to meet the tubing. This is the air-vent. Bend the lower end of the tube at a right angle, place it in a small



From a foot of glass-tubing, a cork, and a pound of plaster of Paris this Bunsen burner can easily be made

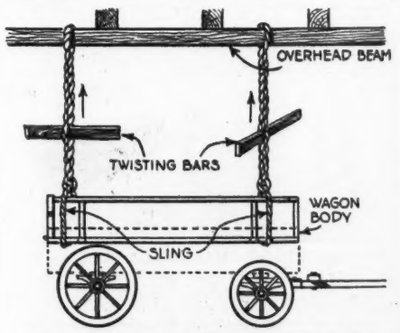
pan or box, and fill it with plaster of Paris. When dry, this can be filed and finished to form a base.

The flame can be adjusted by pushing the upper tube closer or farther away from the lower tube.—H. E. MENDE.

Lifting Wagon Bodies without Special Tackle

SHOWN in the illustration is a simple method of handling a wagon body or a truck body where no special tackle is available.

This consists of running the wagon or truck underneath some overhead support,



The method suggested here is primitive, but will serve its purpose if no lifting-crane is available

such as a ceiling beam in the barn. Two loose loops are secured at the forward and rear ends of the body. From these two loops are run over the beam. With two short bars the ropes are twisted, which shortens them and raises the body. After the wagon or truck is removed from under the body, this is lowered by unwinding these ropes. The body is retained in an elevated position until it is desired to replace it.

Practically any size of body can be removed by this method, particularly the heavy bodies used for spreading manure.

Grow Up To Your Bigger Self

Don't be a mental midget or just the "general run" of man. Scientists declare that the mind of the "general run" of man grows very little after he is eighteen or twenty years old.

But mind, like muscle, will grow if you feed and exercise it properly—will keep on growing after you are twenty, thirty, or forty or older.

The world is demanding, as never before, men of good character with well-developed minds—minds ready for specialized work, for bigger jobs, for positions as leaders.

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The United Y. M. C. A. Schools exist for young men ambitious to realize their Bigger Selves, who are willing to use their spare hours to that end. During the last twelve months 140,000 such young men have enrolled in the resident classes of the United Y. M. C. A. Schools or for the correspondence courses offered by the Extension Division.

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Mark and mail the coupon today for free information as to how we can help YOU to realize your cherished ambition. A copy of "Head and Shoulders Above the Crowd—How to Get There" and other valuable information will be sent.

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—Mechanical Engineer	—Plumber
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The Simplex Oil Burner installed in your ordinary coal or wood stove makes it an efficient Gas Stove. Just turn a valve and get even heat instantly. No coal or wood; no fires to make. No ashes and smoke. Solves fuel problem. Saves hours work. Cooks and bakes better. Absolutely safe and simple. Any child can operate it. Doesn't change or damage stove. Saves money. Makes its own gas from kerosene (coal oil). Cheaper, quicker and cleaner than coal or wood. Five year guarantee. Write for free literature and Special Offer today.

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HANSEN HALLIBURTON MFG. CO.
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New Life for Motors

Nu-Life PISTON RING EXPANDERS GIVE LIFE TO THE MOTOR

"Nu-Life" Piston Ring Expanders are placed under piston rings to restore their life. They absolutely stop oil pumping, cure piston slaps, increase compression, reduce noise and carbon deposits, save oil and gasoline, and give life to the motor, without installing over-size rings or pistons. Made for all types of motors. To obtain best results install one under each piston ring. **Price 25c each.**

Ford Owners: Send $3.00 for a Complete Set.

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BE A RAILWAY TRAFFIC INSPECTOR

Earn up to $250 per month

Position GUARANTEED or Money Refunded

THERE are hundreds of openings for trained Railway Traffic Inspectors. The work is fascinating and easy to master. Any average man can qualify. Steady employment with many opportunities to travel and see the country.

Start at $110 per Month

expenses paid—after 3 months' spare-time study at home. Advancement rapid with experience. Earn up to $250 per month. Your work brings you in contact with big railway officials and opens up splendid opportunities.

"My Salary Was Raised"

Read what Mr. James M. Hurt, Jr., says about the work:

"After finishing your course in Traffic Inspection about three months ago, I was placed in a permanent position at $110.00 per month. Several days ago my salary was raised to $135.00 per month, and I have every reason to believe it will go higher soon if my work is satisfactory.

"Have come to the conclusion that there are very few classes of work in which the opportunities are as unlimited and at the same time, the work as pleasant as Traffic Inspection."

Also read what Mr. W. J. Sugg says:

"Since completing the course, I have been employed by one company in the most pleasant work that it has ever been my good fortune to be engaged in. I received a raise in my salary soon after beginning with this Company. Without your wonderful course, this could never have been possible. I feel I can't say too much for the Standard Business Training Institute and its good promoters."

You Take No Risk

Our Guarantee is that if after completing the course (in your spare-time) we do not provide you with a position paying at least $110.00 a month and expenses, we will refund your enrollment fee in full. You have nothing to lose!

Write today for full particulars and free Booklet No. D401. Don't delay!

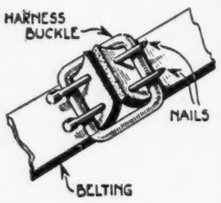
Standard Business Training Institute

Buffalo, N. Y.

THE HOME WORKSHOP

One Method of Making a Quick Belt Repair

IF a small driving-belt, or a leather strap of the harness should break or become unfastened, an emergency repair can easily be made by using an old harness-buckle and two or three wire brads of adequate length.



Remember this hint; you may need it some day

Punch small holes through the leather near the ends of the strap or belt and push the brads through these holes as shown in the accompanying illustration. The buckle should be placed on the outside of the belt, where it will not interfere with the efficiency of the pulley.—C. A. BLACK, JR.

You Can Prevent Faucets from Splashing

SOME faucets will splash very badly and especially so when the water pressure is excessive. A simple and effective means of preventing this splashing is as follows:

Bend a piece of thin spring brass or phosphor bronze, ¾ in. in width and thin enough to be easily bent into position to the shape shown in the picture. Its diameter should be larger than the mouth of the faucet. Insert it into the mouth of the faucet and it will be held firmly in place by the spring action.

The curved spring prevents splashing

This shape breaks up the whirling rotary effect of the stream and causes it to flow in a smooth unbroken stream without any splashing.—B. F. DASHIELL.

To Prolong the Life and Efficiency of a Broom

WHEN using a new broom, the straw is easily broken because of its length, strewing the floor with the broken pieces as well as shortening the life of the broom. A piece of string tied around a new broom about 6 in. from the bottom will hold the straws together and prevent them from breaking, thereby increasing the life of the broom. Besides, sweeping will be much easier, as this will cause the broom to have more stiffness.—B. FOX.

This method will prolong the broom's life

ALL-SOLID COPPER

Non-Explosive AIRTIGHT

FIREPROOF

Made of 16-18-20 and 22 oz. best clean 100 per cent pure copper. No solder inside; all solder outside. The can screw is five inches in diameter. Large enough for hand, easily cleaned. These cans are built to last a lifetime of strenuous wear. Every part—the spout—the can—screw, etc., is individually, solidly and perfectly fitted.

SPECIFICATIONS		PRICE LIST	
Size	Diameter	Height	
2 gal.	8 1-2 in.	11 in.	$ 5.00
4 gal.	11 3-4 in.	13 1-4 in.	7.50
6 gal.	12 1-4 in.	15 1-2 in.	8.50
8 gal.	13 1-4 in.	17 in.	9.50
10 gal.	14 1-4 in.	18 in.	12.00
15 gal.	14 1-4 in.	22 in.	15.00
20 gal.	18 1-2 in.	24 in.	20.00
25 gal.	19 1-8 in.	26 in.	25.00
30 gal.	20 in.	30 in.	30.00
50 gal.	28 in.	35 in.	50.00

⅜ inch soft copper tubing 30c per foot, ½ inch soft copper tubing 40c per foot. These tubings are cut in 12 and 22-foot lengths, adapted for hot water heaters, steam vaporizers and automobile gas feed pipes.

Packed in strong, plain wooden boxes. Shipped by American Railway Express. Send draft or money order to cover or we will ship C. O. D. Orders shipped same day as received. To Jobbers: Write for our price list in quantities.

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Send for free booklet. Agents big profits. Manufactured and Guaranteed by "EVER-FLO" PEN COMPANY College Point, New York

Floor Surfacing Contractors Make $5,000 to $15,000 or More Yearly

This is a new and uncrowded field. General contractors know the American Universal and prefer its work. We furnish office forms, advertising cuts, business cards, mailing cards; in fact, we set a man up in a business of his own. Small investment, no previous experience necessary.

Re-Surfacing Old Floors

Don't Ever Get Caught Out of Work Again—No Dull Seasons in This Business. Hundreds of floors really need re-surfacing right in your own town—your own neighborhood, in the homes of people who can well afford to have the work done and are anxious to have you do it when shown the American Universal Method. American Universal Electric Floor Surfacing Machines can surface more floors in a day than five or six men could do by hand and will do it better and easier. Every builder is a prospect. Machine will pay for itself the first month and pay you a good profit besides.

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A government inspector said he couldn't compare hand work with the machine, because it was far better than hand work. He said he could pass your machine's work, for it was the best work he had ever seen and he had been an inspector for nine years.

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Don't pass up this opportunity to get into a business of your own. Clip out this paragraph and fill in the information requested. ( ) I want to become a Floor Surfacing Contractor. ( ) I am not now a contractor of any kind but was in the following business——— ( ) I am a Building Contractor and want to use it on my own contracts. Send us your name and address and we will send you complete literature on our proposition. Write today.

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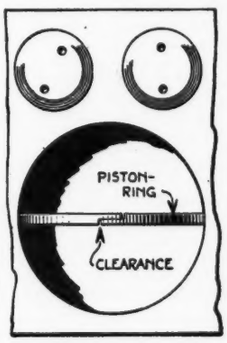
To Determine Clearance for New Piston-Rings

IN placing new rings on the pistons of the automobile or tractor, care must be taken to allow sufficient clearance at the lap of the ring to account for the expansion when in operation. Otherwise the ring will scrape the cylin der walls and possibly score the surface and soon stop the motor.

The amount to leave for this is usually guessed at when repairs are made outside of the factory. All new rings are made large to allow for close fitting, and the ends of the lapped joints have to be filed to the proper fit.

To determine how much space to leave, place the ring in the cylinder edgewise as shown in the cut and then attempt to turn it in the position that it will occupy when on the piston. File the ends until it will thus turn and the proper clearance is allowed for. It will be noted that the ring, in being turned, will be compressed more as the edges of it come in contact with the walls than when it is in proper running position. If the ring is of the beveled-end-lap type, the thickness of a postal-card must be left between the ends on the 3- to 5-in. diameter pistons.



Try this way of measuring new piston-ring clearance

Illuminated Window-Sign Is a Good Advertisement

HERE is an illuminated window-sign that advertises at night at no cost for upkeep and small initial cost.

Remove the window-shades and unroll them on a piece of cardboard. Draw the desired name or design on the shades so that they will read correctly from the street. Now cut out the letters or design with a sharp knife and paste a sheet of tissue or tracing cloth over the whole and the sign is finished.

Plain shades may be transformed into attractive illuminated window-signs

Replace the shade and roller on the window-brackets and your sign is ready to unroll and to be illuminated by the artificial light within the room.

BENEFITS in More Than 50 Ailments

Are you suffering from aches, pains or lack of energy and strength? Have you any weakness or painful disorder that does not respond to ordinary treatment? Then you should know how quickly and permanently you can be benefited by Violet Ray treatment—how the body-building forces of electricity will speedily restore your health. Our free book, "Health for All," tells the whole wonderful story. It tells how to "take your electricity sugar-coated" by using the

Simple manner af applying RENULIFE Violet Ray for Neuritis, pains, etc.

RenuLife VIOLET RAY HIGH FREQUENCY

The penetrating forces of revitalising electricity strengthen and invigorate

You spray thousands of volts of vitalizing electricity into any weak organ, tissue or muscle. It stimulates and invigorates without shock, jolt or jar. It immediately draws to the weakened part a vigorous surge of warm, fresh blood that relieves congestion and pain and permanently rebuilds broken-down or sluggish organs.

Violet Ray treatment is fundamental—not merely local. It fills the blood with germ-fighting white corpuscles and increases its oxygen content. It tones up the nerves and muscles as well as the weakened tissues and organs. It promotes the elimination of waste products. It penetrates and saturates the entire body, and tends to normalize and strengthen every nerve, muscle and organ.

Unequaled in driving out pains and aches.

Treat Yourself At Home

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THE HOME WORKSHOP

Improvising a Watch-Chain from Safety-Pins

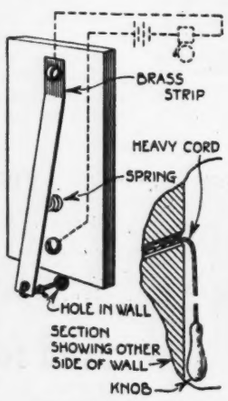
SAFETY-PINS have been used in cases of emergency for so many different purposes that they may be considered a dangerous rival of the ubiquitous hairpin.

The accompanying illustration shows how a fairly safe and serviceable watch-chain may be made from a number of safety-pins. The pins are linked together to form a chain. One of the end pins is linked through the stem-ring of the watch, while the other may be linked through a buttonhole of the vest or passed through the cloth of the coat to insure the safety of the timepiece.

Safety-pins make a good substitute for a broken watch-chain

Method of Giving Electric Bell Signals

INSTEAD of the ordinary push-button a latchstring is pulled. This pulls a piece of springy brass strip forward, which makes contact with a screwhead. This completes the circuit and rings the bell.



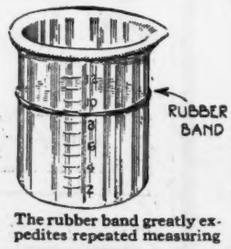
Pull the latchstring and the electric bell will ring

The little circuit-maker is very simple, consisting of a brass strip held down at one end with a brass bolt. A spring holds the strip of brass away from the contact. The opposite end of the brass strip has a hole drilled in it and the string that passes through the partition is tied to this.

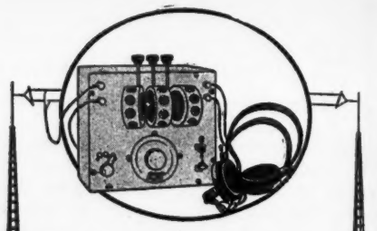
Chemists Will Find This a Useful Aid

WHEN mixing compounds it is often necessary to add a certain amount of a liquid frequently. The graduations of the measuring glasses are very fine and accurate measuring requires much time.

By placing a rubber band at the level wanted, it is possible to quickly pour the liquid to that point, as rubber is easier to see than the graduations would be.



The rubber band greatly expedites repeated measuring



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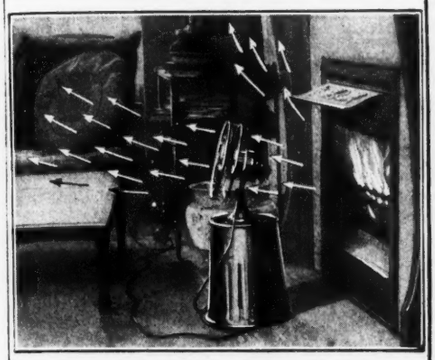
THE HOME WORKSHOP

Heat Can Be Blown where It Is Needed

MOST houses are insufficiently heated. The heat supplied by fireplace, furnace, or stove seems insufficient because it is not forced where it is most wanted. Since heat rises, whether it comes from an open fire, a gas log, or a steam radiator, the heat waves curve directly upward unless deflected in some way. This is where the electric fan comes in.

The electric fan gathers the air from behind it and sucking it through the fan, blows it out in front. If a fan is placed in front of the source of the heat, it will do the same with the heat waves. In this way,



By means of the electric fan, the heat from the grate fire will be distributed through the room

the heat, instead of making straight for the ceiling, can be blown out into the room for some distance at a level with its source and can be felt at a much greater distance from the source than if there were no fan used.

The distance the fan should be placed from the heat source, depends, of course, on the radiating surface and the intensity of the heat.

Improvising a Practical Funnel for an Emergency

THERE are times when you need a funnel for filling a tank or vessel. From a near-by trash-heap, or possibly from your baggage-kit, a practical substitute can

In cases of emergency the broken-off top of a narrow-necked bottle can be used as a funnel for filling tanks or other vessels

easily be secured. A bottle, the neck of which will fit into the opening of the tank or vessel to be filled, will serve as a satisfactory funnel if the bottom is broken off.—CHARLES A. GODDARD.

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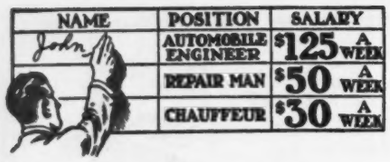

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How I Listen In on the World by Radio

(*Continued from page 22*)

"loose coupler." This is a "tuning" device. The simple outfit with which I started was as careless as a pup about what it brought in. If there was music, amateur traffic, and government business in the air at the same time, it brought them all to my listening ear and it sounded like a Morse family quilting-bee with everybody talking at once. The "loose coupler," by a few simple adjustments, put out everybody except one person and locked the door. If I got tired of listening to that one, a simple twist of the wrist would put him out and bring in another.

The practice end of radio was becoming so fascinating that I decided to learn something of the theory. I joined the Y. M. C. A. class and in less time than most men spend quarterly at the picture show, I had qualified for and received a government license as a radio operator.

Then one day I discovered the vacuum-tube detector. It looks like an electric light, but when you hook it up, it yells like the barker outside a side show. A storage battery lights the filament just as in the case of an automobile lamp. A dry battery connects with a plate in the vacuum tube just as it would with the automobile's ignition system, although in this case there is no spark, just a noiseless flow of current. The knobs and switches which control the vacuum tube are all plainly marked. Within an hour I was familiar with the different adjustments.

While using my old apparatus I had always been obliged to "sh-sh" the family because the sounds which I heard were not loud enough to compete with their voices. But with my vacuum-tube detector the phone sometimes talked so loudly that I could hang it on a hook, lean back in my chair, and still hear everything distinctly.

One winter's night I was amusing myself by seeing how many different stations I could hear. I had purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., lists of all the amateur, commercial, and government ship and shore stations of the United States. Also I had purchased from a private concern a list which included foreign ship and shore stations. One station in calling another gives the call letters of the station called, then the French word "*de*," meaning "from," and then its own call letters. By looking in the book I could find out who was calling whom.

The vacuum detector and the tuning outfit that went with it not only brought in all the stations I had been able to hear with the less efficient apparatus, but many more. The old apparatus seldom made audible any signals from stations more than three hundred miles away, nor from those which sent out electrical waves that were more than 1500 meters from crest to crest.

The new receiver would bring in messages from much greater distances. I began with the lower wave lengths and several amateur stations and numerous ships of various nationalities. A number of these were sending "QTE" to NAH, the New York naval station. Freely translated, this means "Where am I at?" None of these ships was lost, but their skippers knew that our government's radio compass-stations at Fire Island, Sandy Hook, and Mantoloking can determine a ship's position night or day, in sun or storm, more accurately than her own navigator can. Raising my receiving wave length I heard successively Key West, Santiago de Cuba, Bermuda, and, finally, at the upper limit of my tuning range, I was amazed to hear POZ in Nauen, a suburb of Berlin, talking with the Annapolis naval station! The simplicity of the thing was staggering. I was hearing a conversation across five thousand miles of land and sea as easily as though it were in the next room. Recovering from my amazement, I started down the scale again. I had just reached 600 meters when a faint signal caught my ear.

"SOS."

The skin tightened on my scalp as it did once when I was awakened in dead of night by a crash outside my window. Here was a tragedy of the seas being enacted within my hearing! I wrote down the call letters of the ship in distress, and the words: "on fire." At that moment, before I could catch her position, there came an interruption. Traffic from ship to ship and ship to shore often breaks out in bursts. Into the babel came a string of signals stronger

(*Continued on page 103*)

Facts a Beginner Should Know about Wireless

THE following publications may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C.:

"Commercial and Government Radio Stations of the United States," 15c.

"Amateur Radio Stations of the United States," 15c.

"Radio Communication Laws and Regulations," 15c.

"The Radio Service Bulletin," issued monthly, 25c a year.

A Radio Call Book containing the call letters of foreign ships and shore stations, as well as those in the United States, may be purchased from any dealer in radio equipment for $1.50.

Every beginner should register at once with the United States Navy Amateur Bureau and receive a copy of the secret codes used in transmitting amateur broadcasts at slow speed. Application blanks can be obtained from Seascout Radio Commodore, Boy Scouts of America, 200 Fifth Avenue, New York City, who handles these for the Navy as a convenience to those interested in wireless.

For information concerning local broadcasts that you would like to receive, consult local dealers, near-by amateurs, or write to the Chief Radio Inspector, Bureau of Navigation, U. S. Department of Commerce, at any one of the following cities:

Boston, Mass.; New Orleans, La.; Detroit, Mich.; Baltimore, Md.; San Francisco, Cal.; Chicago, Ill.; New York, N. Y.; Seattle, Wash.

Membership in a national organization of radio amateurs will be found helpful. Some of the most active are:

American Radio Relay League, Hartford, Conn.

National Amateur Wireless Asso., 326 Broadway, N. Y.

How I Listen In on the World by Radio

(*Continued from page 102*)

than the rest. I tried to tune them out, but from my lowest wave length to one far above that on which the SOS was coming, they were clear and strong.

Pausing a moment to read the signals, I discovered that it was NAH repeating, over and over again: "QRT for SOS." Bluntly speaking, it meant: "Shut up until Uncle Sam gets a ship out of trouble."

In five minutes the ether was as silent as a deaf-mute asylum. Then in tones that could be heard anywhere in the Atlantic, NAH tersely told the situation and gave directions. Three ships nearest the one ablaze were detailed to go to her relief. Then the broad, interfering wave of the navy station gave permission for the resumption of traffic.

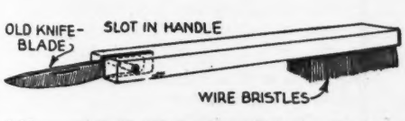
And so, every day, no matter when I listen in, my radio receiver brings me some item of thrilling interest from afar. It is not a passive sport, this radio game. With my transmitting apparatus I can exchange messages with neighbors five to ten miles away. And, all the radio adventures that I am having, any man or woman, boy or girl, can duplicate. I began when I was past forty and with only a few dollars' worth of apparatus. With just my old mineral detector and single phone on July the second I heard a description of the Dempsey-Carpentier prize-fight, blow by blow, given by an expert at the ringside. For this experience I was indebted to the National Amateur Wireless Association, which served an area of 125,000 square miles with its radiophone reports.

A thousand mysteries of the air are open to the man who will buy a cheap radio receiver and begin. All the technical education he will need he can pick up as he goes along. Even though his increasing interest leads him to purchase better and better apparatus, as I have, his hobby will cost him far less than the tobacco habit, and become not only a fascinating recreation, but a necessity as great as the daily paper.

For those who wish to make their own radio sets, a series of helpful and instructive articles on this subject will appear from month to month in the Home Workshop department.

How to Make Improved Spark-Plug Brush

THE handy spark-plug cleaning-brush can be made much handier by cutting a narrow slot in the end of the handle with a



Add an old knife-blade to the spark-plug brush and increase its usefulness

hacksaw and inserting an old pocket-knife blade.

The knife blade is ready to use in an instant for scraping out heavy carbon deposits from inside the spark-plug shell that the brush can not reach.—J. C. OTTOFY.

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Various Uses for the Handy Safety-Pin

BESIDES its original intent, the safety-pin has other uses. It is an excellent substitute for the more expensive film clip to hang up and dry films. The point of the pin is pushed through the film and, the pin left open, the curve of the catch thus forming a natural hook by which it is hung on the suspended cord.

A number of safety-pins linked together forms an extemporized chain of varied uses.

The safety-pin makes a good ever-ready paper-file. By fastening it against the wall or desk by means of a double-pointed tack, it may be left open, or when desired, be closed, thus insuring the safety of its file. When not in use it can be pushed flat against the wall.

Four uses for safety-pins

When traveling, pin your ticket into your pocket with a safety-pin and you will always know where to find it.

It is ideal to hold temporarily a small bouquet of flowers.

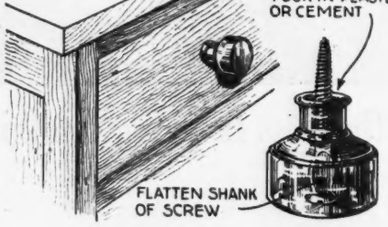
Use a safety-pin, for want of something better, to hold your sheets of paper together when writing, and your recipes, scrapbook items, etc.—A. SCHAAL.

Drawer-Knobs Evolved from Glass Bottles

SMALL old glass bottles make excellent knobs for use in home joinery, as is shown in the picture below.

I have taken a number of them to re-knob kitchen furniture.

I took a dozen empty small drawing-ink bottles, filled each one with a paste of plaster of Paris in which I embedded a



Small glass bottles are easily changed into ornamental knobs for doors or drawers

wood-screw hammered flat near its head, as shown in the illustration. Then I let the plaster of Paris set thoroughly.

These homemade knobs were screwed in the woodwork and served their purpose very successfully,

If desired, concrete may be used instead of plaster of Paris. The paste may be colored any particular tint or shade to match the furniture, and to give to the knobs a more attractive appearance when in place.—GEORGE H. HOLDEN.

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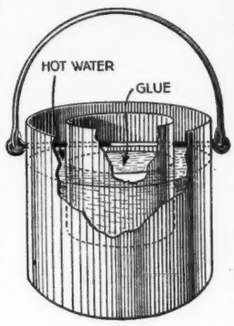
THE HOME WORKSHOP

A Glue-Pot Fashioned from a Tin Can

THE glue-pot shown in the illustration consists of two tin cans, one a large tomato can, and the other a smaller milk-can. The top is cut off with the aid of shears, and the edges are filed off smooth. Then holes, ⅛ in. in diameter, are drilled as near to the top of each can as practical. Through these holes a strong wire is passed, looped at one end, then it is passed through the smaller can, and finally looped again as it emerges from the large can.



Glue will never be scorched in this home-made glue-pot

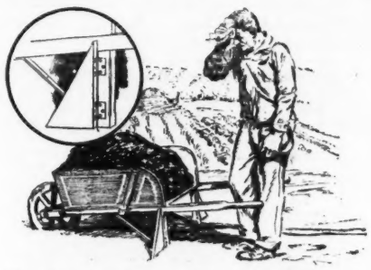
Through these two loops another wire is passed and tightly fastened. This is the handle. The large can is always kept half filled with water; the smaller can is filled with carpenter's glue. Whenever the glue is wanted, it is placed on the stove or over an alcohol flame, to make the water boil. Allow the water to boil a few minutes and the glue will be warm and ready for use. The brush with which the glue is applied can be kept in the can, and the excess glue brushed out on the rod passing through the can.

When it is desired to use the glue over an extended period, the water can be kept simmering burning the glue.

Prevents Wheelbarrow from Tipping Over

SOMETIMES a loaded wheelbarrow will tip over and deposit its contents upon the ground. This often happens upon tilled ground or soft earth. Here is a way to prevent it:

Cut two triangular pieces of strong board the height of the wheelbarrow leg and about 8 in. wide at the base. Hinge



These braces make it possible for the workman to wipe his brow without risk of spilling the load in the barrow

the long edge to the outside of the leg, with the base flush with the bottom. Place the hinges so that the boards will swing forward and lay flat against the body of the barrow when not in use. These hinged flaps may be held in position by a hook or a spring clip.

When it is desired to steady the barrow, swing the boards out on each side until they project at right angles. In this position they give a much greater breadth of base and keep an uneven side load from tipping over the barrow.—L. B. R BBINS.

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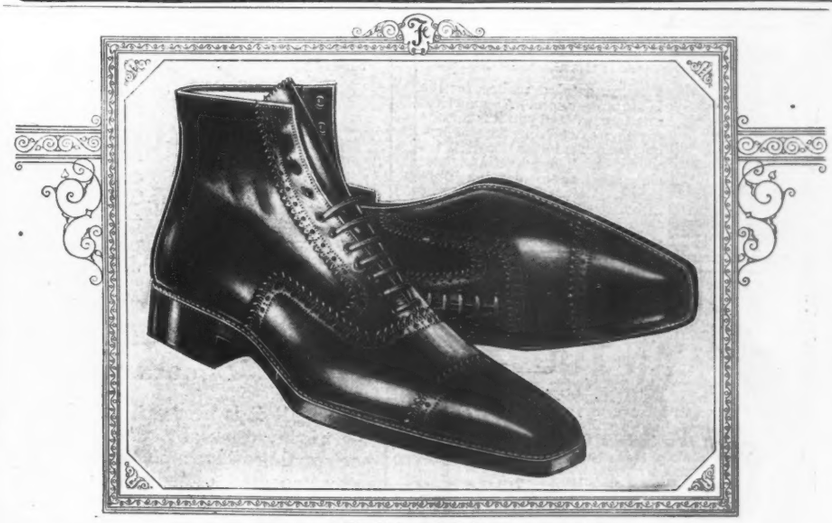

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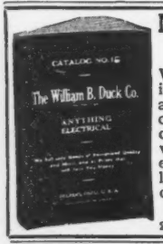

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METAL caps on grape-juice, soda, and other bottles should be saved, and when enough are accumulated, a good ice-scraper can be made. The caps can be nailed to the bottom of an old broom, when

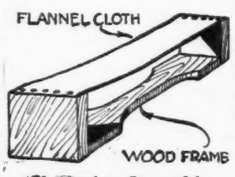
Why not make an ice-scraper like this? The time when you will need one is rapidly approaching

the hair is all gone. A few small nails through each cap will hold it.

When this homemade device is pushed over an icy sidewalk, the ice will be scraped off by the sharp edges of the bottle-caps.—ARTHUR GOLDENBAUM.

Use Up Old Rags for This Shoe-Brush

A GOOD substitute for a shoe-brush can be made from some old cotton or flannel rags as shown in the illustration herewith.



Shoes take a fine polish if treated with this homemade flannel polisher

First the wooden frame is made and the middle piece cut with a jack-knife to form a convenient handle. The rags are tacked to the end pieces as shown.—J. B. MORAN.

Flashlight on Rifle for Night Shooting

OFTEN it is necessary to use a rifle at night, especially where coyotes and nocturnal prowlers are troublesome. Without some kind of light it is next to impossible to score a hit.

This difficulty may be overcome by attaching a large flashlight to the rifle barrel with clamps, as shown in the accompanying illustration. When you are ready to use the rifle, turn on the flashlight and

With a powerful flash-lamp attached to the barrel of your gun your marksmanship will not be handicapped by darkness

you may pick a vulnerable spot and bring down the intruder with one well-aimed shot.

The writer of this article has used this method very effectively on neighborhood cats that became too noisy for his peace of mind.—E. G. GETTINS.

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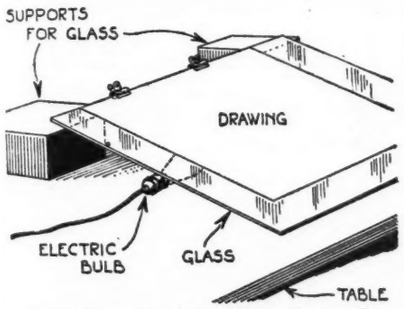
When Tracing from Old Drawings or Prints

THE draftsman who has occasion to trace from blueprints knows what a strain it is to the eyes. Likewise copying drawings from old tracings that are worn and faded is a difficult matter.

Much time may be saved and much labor and eyestrain avoided if the draftsman uses a case with a glass top for the drawing-board. An exhibition case makes an excellent drafting-table for the purpose. Any case with a glass top, a loose window-sash, or even a loose piece of plate-glass, such as used for a desk-top, may be employed.

The glass top is used as a drawing-board and the under side of the glass is illuminated by an electric bulb, the amount of illumination depending upon the clearness of the lines and on the transparency of the material on which the drawing is made and on which it is to be traced.

When copying on tracing-cloth, daylight illumination may be sufficient, but

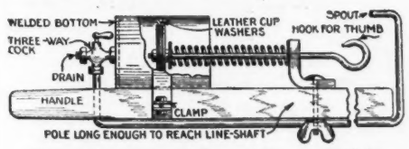


Drawing on this plate is like tracing on the window-pane, but far more comfortable and efficient

when copying from blueprints or translucent paper, electric bulbs on the under side will greatly facilitate the work. Small weights take the place of thumbtacks, unless a special case is constructed with a flush wood frame.—B. Fox.

Safety Oiling Device for Machine Shafting

THE accompanying illustration shows a safety and labor-saving device for oiling shafting. To fill the cylinder the thumb is inserted into the hook and the plunger withdrawn from the cylinder. The wing-nut is then loosened so that the plunger



If you rig up one of these oilers, you will be able to lubricate your shafting without risk of accident

may be swung to the side and the cylinder filled. The plunger is then replaced.

To use this device the spout at the top of the pole is placed in the oil-hole and the cock is slightly opened. The oil will then be forced through the tubing into the oil-hole.

To empty drip-pans, etc., insert the spout into the pan, open the cock, and pull up the plunger. The cylinder is then emptied by placing the three-way cock in the other position and allowing the oil to be forced out through the drain.

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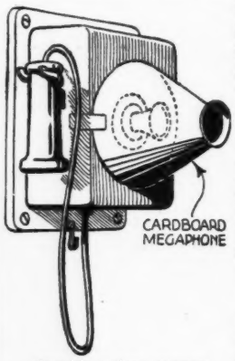
THE HOME WORKSHOP

Reduce Noise Over the Shop Telephone

IN noisy shops much of the noise is transmitted over the telephone when it is used and the party at the opposite end has a difficult time hearing. This can be avoided by the use of a heavy cardboard megaphone attached to the telephone transmitter, as shown in the illustration.



Outside noises cannot reach the transmitter if it is protected as shown here

This attachment will make the voice louder and tend to shut out undesirable noises.—J. B. MORAN.

How to Cut Heavy Sheet Metal with Shears

FEW amateur mechanics know how to cut heavy sheet metal with a pair of tinner's shears. The illustration shows the best way of doing this.

One handle of the shears is held in the vise and the other handle is manipulated

Try this method of using the tinner's shears; you will find it convenient and labor-saving

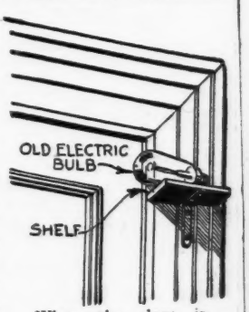
with the hand. When held in this way, the cutting of the heavy metal will be found very easy.

It is only necessary to guide the metal with one hand and force the shears downward with the other.

An Electric Bulb Becomes a Burglar Alarm

WHEN an electric bulb is allowed to drop on the floor and break, there is considerable noise. This can be utilized as a burglar alarm in the manner shown in the drawing.

A small shelf is placed near the door and an old bulb is placed upon the shelf. This is so placed that the opening of the door will cause it to drop off and break. The noise produced will be sufficient to arouse the occupants of the house. — J. B. MORAN.



When the door is opened, the lamp will drop on the floor, alarming the whole house

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Oxyacetylene Cuts Steel Disks in a Drill-Press

STEEL disks may be cut to exact diameters with an oxyacetylene flame in an ordinary drill-press in the manner shown in the illustration.

The oxyacetylene cutting-tool, which is specially designed for cutting sheet metal and differs from the more common welding-tool—is secured horizontally to the chuck on the drill-spindle, which remains stationary.

The sheet steel to be cut is then centered and clamped to the table of the drill-press. A previously punched hole at a point on the circle to be cut (or a hole formed by the flame) is first provided, then the drill-press

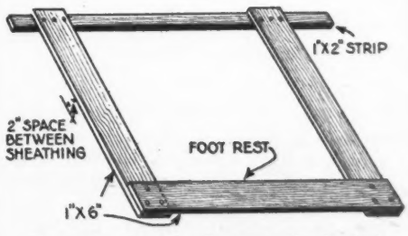
This method of cutting steel disks is well worth trying; it is efficient and accurate

table with the sheet-steel plate clamped to it is rotated by hand, and the flame cuts sharply and quickly, following an accurate circle.—T. A. HOE.

Making a Scaffolding for Laying Shingles

WHEN it becomes necessary to shingle a dwelling or barn, a scaffolding is required strong enough to support the weight of the man or men laying the shingles.

Any one who knows how to use a saw and a hammer can easily make the simple



Four strips of wood, a hammer and a handful of nails is all that is required to make this roofer's scaffolding

scaffolding shown in the illustration from a few pieces of narrow flooring. The dimensions of the frame should be so chosen that the frame fits between the sheathing boards. The feet of the workman rest on the heavy bottom piece as indicated in the diagram.—WILLIAM E. KING.

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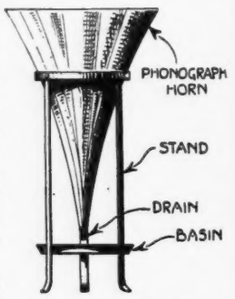
THE HOME WORKSHOP

A Phonograph Horn Makes a Novel Flower-Pot

AN old morning-glory horn, such as was used with the old cylinder phonographs, and an old umbrella-stand combine to make a very pleasing flower-pot stand for a sunny window.



An old phonograph-horn combined with an umbrella stand makes this flower-pot

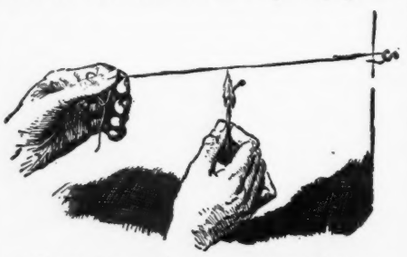
The horn should be given a good coat of tar or black asphaltum on the inside and a coat of enamel paint on the outside to prevent rusting. It should then be set with the large end up, as shown in the accompanying illustration, and filled with good rich earth.

The little end will serve to drain any excess water into the drip-pan of the umbrella-stand and the depth of the horn provides sufficient space to prevent the plant roots from cramping.

To Straighten Curled or Twisted Gut

THE gut with which fishhooks are snelled has always a tendency to curl and twist up after drying, making it inconvenient for the fisherman to assort or handle them.

To straighten gut that has become curled, hold it stretched taut and quickly pass a lighted match under the entire length of gut so that the tip of the flame barely touches the gut. The flame must not be stopped at any one point, as it is apt to burn the gut.—B. Fox.



Here is shown a simple method of straightening the catgut snells which became twisted after drying

An Old Flatiron Made into a Bench Anvil

A HOME mechanic who does not have a big heavy vise will find the suggestion given here of value. An old-fashioned flatiron is held in an upright position by a wooden holder made of three pieces of heavy board. Two-inch material should be used in the construction of the holder, as the anvil is called upon to withstand a good deal of strain when in use.—L. LAURIER.

Resting on this support the old flatiron becomes a serviceable bench anvil

Stop Snuffling

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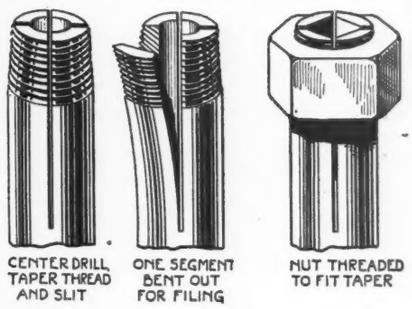
A Wrench or Chuck for Square-Shank Tools

IN the illustration is shown a method of making a small tap or reamer wrench for holding square shanks. A length of steel shafting or similar stock is drilled down the center, the diameter of the hole being a trifle less than the measurement across the flats of the shank of the smallest tool to be held in the chuck. Next, the end of the bar is taper-threaded with a pipe-die. Then two slots, at right angles, are cut with a hacksaw, forming four segments.

By bending these segments out, one at a time, they can be filed flat on the inside and when bent back into place a square socket will have been formed. If the tool is to be hardened, this must not be done until all the bending and filing is complete; if not hardened, it must be carefully used or the socket will wear out of shape.

A nut is now made, either knurled or from a regular hexagon nut; it is drilled

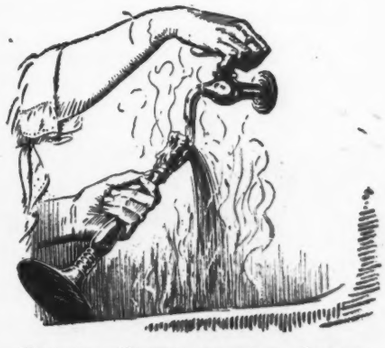


This illustrates a good method of making a wrench or chuck for square-shanked tools

and tapped with a pipe-tap to fit the thread on the shank of the chuck; screwing the nut on to the chuck will draw the jaws together and clamp the tap or reamer in place. Different-sized tools, within limits, can be held in such a chuck; it may be used in the lathe or provided with a cross handle for bench work.—H. H. PARKER.

Cleaning Candlesticks from Wax or Paraffin

WAX, or paraffin adhering to candlesticks can be removed easily by pouring hot water over the parts to be cleaned. The wax will loosen and fall off without any part of it remaining on the candlestick. Either the faucet or the tea-kettle may be used for the hot water.—B. FOX



Hot water will remove every trace of wax or paraffin from your candlesticks without injuring them

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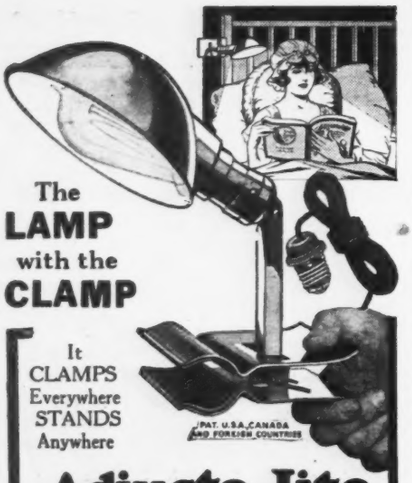

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A STURDY small engine Lathe built with the same quality construction that has made **MONARCH ENGINE LATHES** standard the world over. An accurate, dependable machine tool especially designed for and guaranteed to do any small work that any other lathe will do with speed and accuracy.

MONARCH JUNIOR will fit in any shop or in a work-room right in your own home. They are especially designed for beginners—are easy to learn to operate and are equipped the same as any larger lathe.

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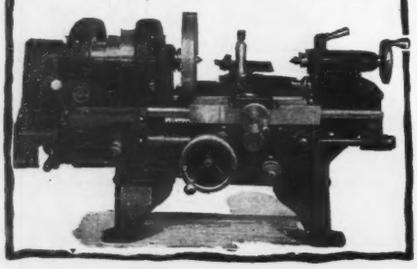
Monarch Junior 9 inch Engine Lathe $250

Full particulars and a Monarch Junior Catalog will be sent you on request.

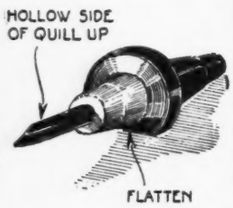
The Monarch Machine Tool Co.
201 Oak Street, - - Sidney, Ohio



THE HOME WORKSHOP

Keeps the Ink-Bottle Cap from Rolling

DRAWING-INK bottles are usually provided with stoppers with a pin extension carrying at its lower end a quill that is submerged in the ink and serves for filling the drawing-pen. If the stopper is laid on the drawing-board, it is likely to roll on the paper if the board is tilted or jarred, and many a carefully executed drawing is ruined by smudges from the ink-laden filling-quill of the stopper.

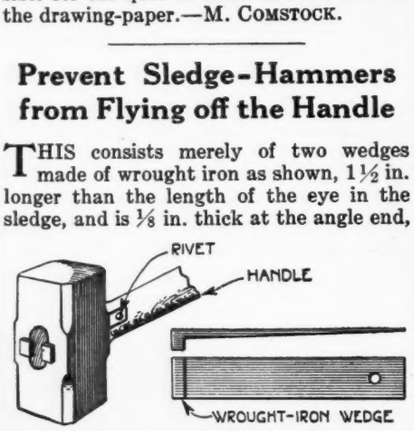


Give the stopper of your ink-bottle a flat side to keep it from rolling

After having suffered through several accidents of this kind, I devised the method illustrated here to prevent further repetitions. I cut the stopper as shown in the picture. The flat side prevents the stopper from rolling and the slant makes it impossible for the quill to come in contact with the drawing-paper.—M. COMSTOCK.

Prevent Sledge-Hammers from Flying off the Handle

THIS consists merely of two wedges made of wrought iron as shown, 1½ in. longer than the length of the eye in the sledge, and is ⅛ in. thick at the angle end,



Two wedges used as shown here will prevent the sledge-hammer from flying off its handle

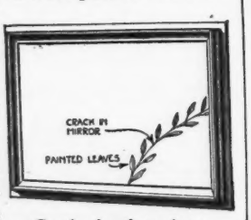
tapering down to nothing at the other end.

After two of these are driven in (one on each side), a 3/16-in. hole is drilled through the handle, a pin put through it, and the ends of the pin are riveted.—L. J. BITNER.

Camouflaging a Disfiguring Crack in a Mirror

A LARGE plate-glass mirror, used at the back of a florist's window, was cracked by an accident. To avoid the expense of replacing the mirror, the florist adopted the following scheme for effectively camouflaging the ugly crack.

A number of leaves were painted on each side of the crack with the stems just touching the crack. This gave the crack the appearance of a branch of leaves.



Cracks in the mirror may be camouflaged by the exercise of artistic skill

Another effective way of accomplishing the same results by one who may not be able to paint leaves, would be to paste some dried pressed leaves on the mirror. This idea can be utilized for cracked mirrors at home.—B. FOX.

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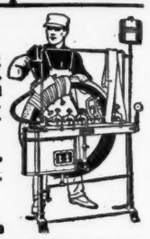

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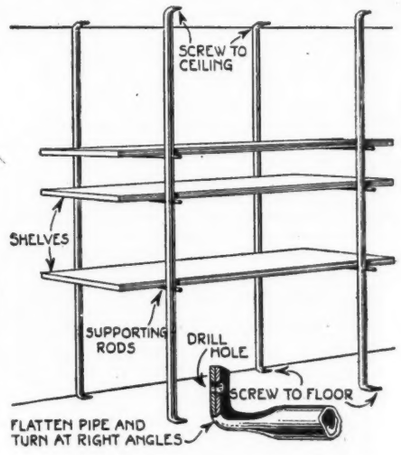
Substantial Shelving Made from Pipe Stanchions

SHELVES of unusual strength and rigidity can readily be made from wrought-iron pipe secured at the floor and ceiling and provided with a series of holes for cross bars, as is shown in the picture.

The pipe used will vary with the weight it is required to support. One-inch size is



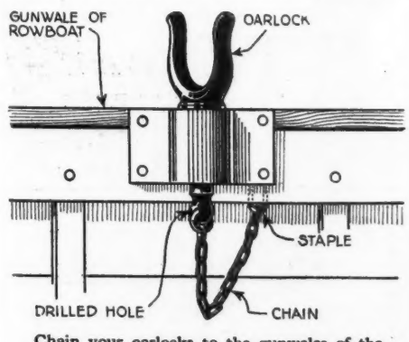
Pipe stanchions form strong supports for shelving which is intended to carry heavy loads

suitable for most purposes and white enamel makes this attractive. The holes permit of varying the distances between the shelves, which shelves are simply planking resting on the cross supports.

This form of shelf is not any more expensive than oak or other wood, as less material is required where metal is used and has the further advantage of showing off the stock by not obstructing the view as heavy wooden frames do.—G. A. LUERS.

Put Oarlocks on a Chain to Prevent Their Loss

MODERN rowboats are, as a rule, equipped with removable oarlocks. These are undoubtedly convenient in some cases, but they are easily pulled out of their sockets and may be lost by falling over-



Chain your oarlocks to the gunwales of the boat to prevent them from becoming lost

board. Their loss may be prevented in the following manner, as illustrated in the picture.

Drill a hole through the shank of the oarlock, draw a ring through the hole, and fasten to the ring a short piece of chain, the other end of which is attached to a staple driven into the side of the boat, near the place for the oarlock.

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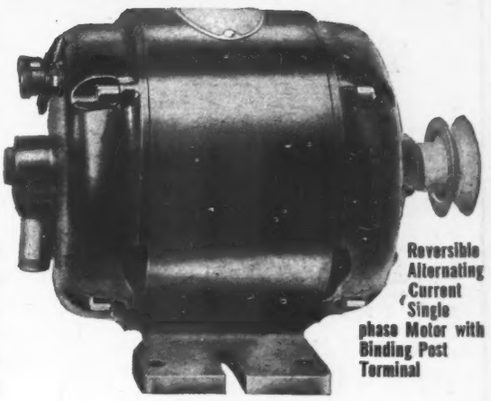

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Motors are of squirrel cage type, air-cooled. They cut out at higher speed and cut in at lower speed than ordinary motors.

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Gramophone Mechanism for Turning the Grindstone

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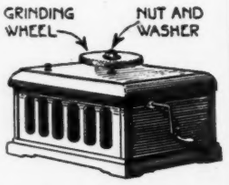


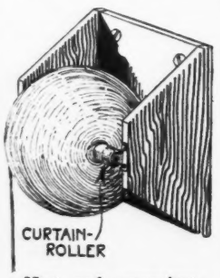
Too old for grinding out tunes, the gramophone will grind your tools

First, remove the revolving table, and cut the disk down to, say, 2 or 3 in. in diameter.

Now thread the shaft end to take a small nut. This done, put on the grinding-wheel and secure it in position with a washer and nut. One winding, and the mechanism is good for a number of tools.

Keep Your Ball of String in This Twine-Holder

SHOPKEEPERS who use twine for tying parcels can easily make a holder like that shown in the illustration. It costs nothing and keeps the ball of string from unwinding.



Neat and convenient is this way of holding a twine ball

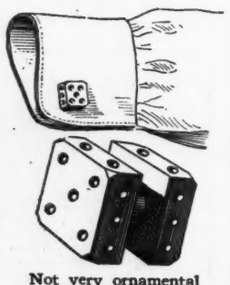
A board, 8 in. long and about 4 or 5 in. wide, forms the base, which is nailed or screwed to a shelf or the wall. To each end of the board a side piece is nailed. A piece of a curtain-roller, long enough to fit loosely between the two side pieces, is provided with the pin-caps of the roller and is placed with its pins in the roller brackets screwed to the side pieces.

The roller forms the support for the ball of twine, which can rotate freely as the string is unwound.—C. A. BLACK, JR.

Cuff-Buttons from a Pair of Dice

WITH a lathe, a file, or a hacksaw, cuff-buttons of striking appearance may be made from a pair of dice. If the dice are of ivory, so much the better, but cubes of bone, celluloid, wood, or any other material are also suitable. In making the cuts, care should be taken not to cut too deep.

The material between the cuts should be carefully removed, so as to leave a stem connecting the two face parts of the button. The picture clearly illustrates the appearance of the button when completed. The method of removing the undesired material depends upon the tools used in the making of the buttons.—JOHN NEUERBURG.



Not very ornamental but useful for buttoning the cuffs

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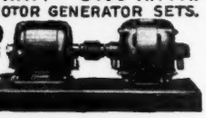

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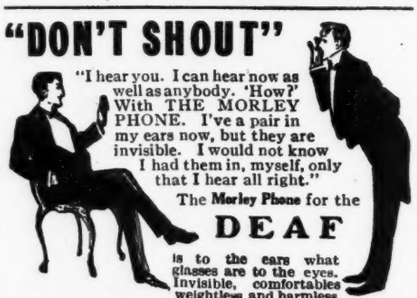

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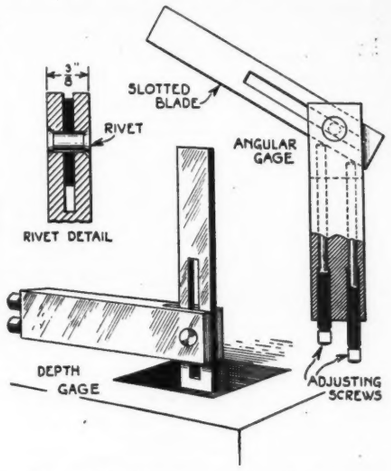
Combined Square and Angle Gage Is Useful

A COMBINATION of a machinist's square and angle gage is shown in the attached sketch. It consists of a slotted blade fitted into a steel bar or stock with a fixed pivot and two adjusting screws through the center of the stock. These adjustable screws permit of setting the blade at an angle or squaring it up with the stock as is required.

The same tool is serviceable as a depth gage, as the blade can be slid endwise and



This combination of a square, depth gage, and angle measure will be found very useful

secured by means of the two set screws. The tool is compact and will fit readily into a tool-kit, affording the machinist three useful tools in one, namely, try-square, angle gage, and depth gage.—G. A. LUERS.

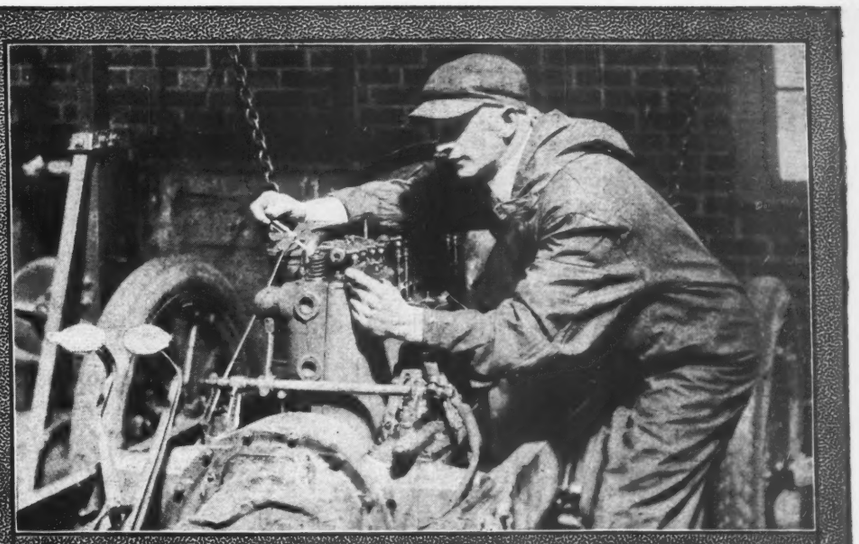
How Baby's Bathtub Can Be Placed Conveniently

TO make a bathtub for the baby a large tin pan can be used. The pan should be provided with two heavy wire hooks at each end. The hooks rest on the

A baby's bathtub that is safe and easily made

edge of the bathtub and a small rubber hose may be used to fill the pan with water from the faucet.

The wire hooks should be carefully soldered to the pan at the bottom and sides. The outside of the pan may be enameled any color desired and the inside is usually enameled in white.—W. C. ROYER.



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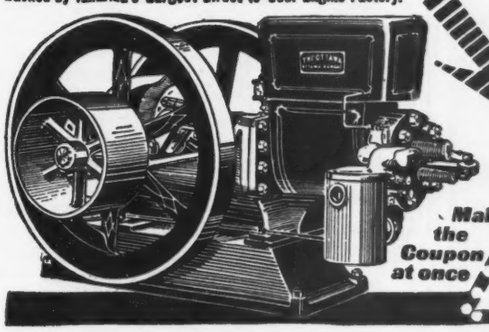

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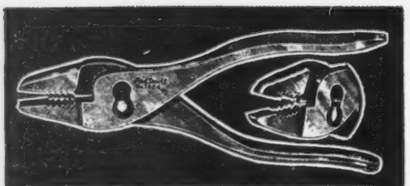

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Marble in Inkwell Prevents Evaporation of Ink

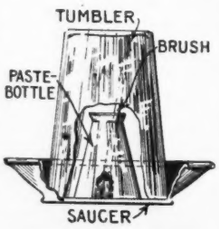
The marble keeps the dirt out and prevents the ink from evaporating

MORE ink evaporates from inkwells in an office than is used for writing; and the result is that that which is left for writing is always made muddy by the remaining sediment.

A means of preventing ink evaporation consists in dropping an ordinary marble over the hole in the inkwell. The marble effectively prevents evaporation, while putting the pen into the ink is no more difficult than otherwise, because the ball slips aside as soon as the pen is pushed against it.

How to Keep Library Paste in Good Condition

LIBRARY paste ordinarily comes in small bottles having a screw top, the brush being "thrown in." To use the paste it is necessary to unscrew the top, then use the brush, and after using make the brush clean again. Very often the brush is lost.

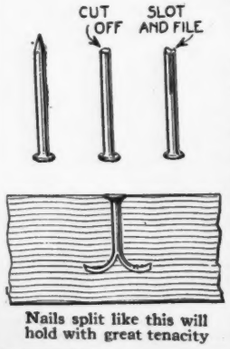


Keep paste as shown here and it will retain its consistency

Here is a plan that takes care of the problem. Put the bottle of paste in a saucer containing some water, and then cover the bottle with an inverted tumbler. The paste is kept fresh, can be used quickly, and it is not necessary to clean the brush after every using. The placing of water in the saucer is not an essential if the paste is used frequently. If used seldom, however, it is best to add the water so that the paste will be kept from drying out.—N. G. NEAR.

Increase the Holding Power of a Nail

HERE is a simple method of increasing the holding-power of a wire-nail or spike. With a flat file remove the point of the nail as shown in the picture and then, with a hacksaw, split the nail for about one fourth of its length. With a triangular file the two halves should be beveled in the manner indicated at the left.



Nails split like this will hold with great tenacity

Before using the nail or spike, drill a hole of the same diameter as that of the nail in the wood to the depth you wish the nail to reach before spreading. Then place the nail or spike in the hole and hammer it down. It will spread as shown.

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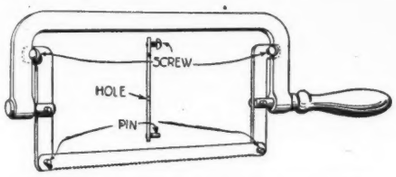
THE HOME WORKSHOP

For Increasing the Depth of a Hacksaw

THE other day I encountered a job which required a saw-slot between two holes in the center of a piece of work. I found the work impossible, as the hacksaw was not of sufficient depth to reach the holes, so I quickly made the arrangement shown in the illustration.

Two pieces of flat stock, of the same dimension as the hacksaw frame, are given a short right-angled bend on one end, which is drilled and tapped for a machine-screw. The straight end of each piece is drilled and fitted with a pin that will pass through the holes in the saw-blade. The centers of the pieces are drilled to pass over



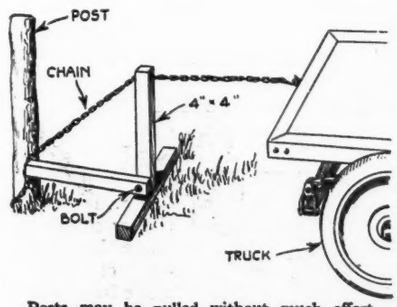
For making deep cuts, attach an extension like this to the two arms of your hacksaw frame

the pins in the hacksaw frame. The illustration shows the pieces in position.

After the saw-blade has been drawn tight, the screws are turned down until the heads pinch on the ends of the frame. This makes the attachment perfectly rigid, besides increasing the depth of the frame.—R. H. KASPER.

Use a Motor-Truck for Pulling Posts

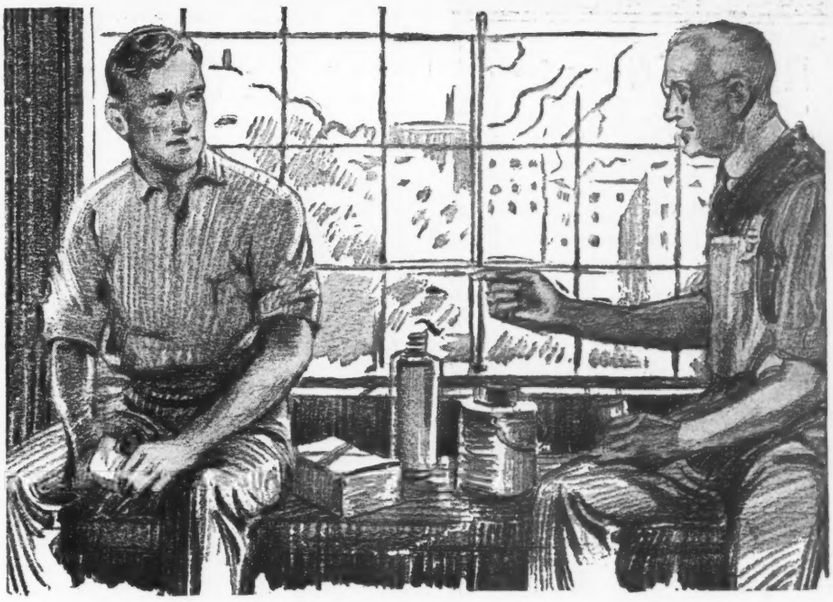
THE power of any motor-truck is sufficient to perform all the chores and hard jobs about the farm if the power could but be applied in the proper directions. Here is shown one of these jobs and the device to



Posts may be pulled without much effort by this lever arrangement operated by a motor-truck

change the direction of force to accomplish it. Pulling posts from a fenceline without breaking them requires a vertical lift, so the jack has to be used. It is made of 4 in. by 4 in. timbers, each piece 3 ft. long. The upright and the base are mortised together, while the side arm is attached with but one bolt so that it can be folded for carrying.

After the chain has been snubbed around the base of the post and the jack set as shown, the truck is started and the post is lifted. The truck need not be stopped until another post is reached, when the one just pulled may be thrown in the truck and the jack arranged for another one. This method saves time and requires but one man.



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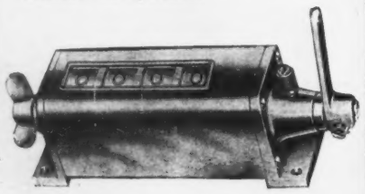

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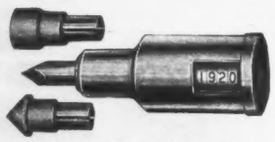

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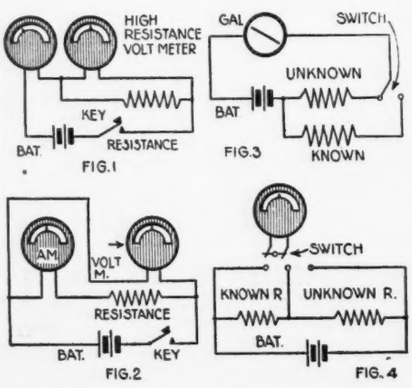
How to Measure Electrical Resistance

By W. H. Hoschke

OFTEN the amateur electrician finds it necessary to make fairly accurate determinations of electrical resistance. Many believe that a costly Wheatstone bridge must be had if resistance is to be measured. This is not so, however, since very reliable determinations of electrical resistance, accurate enough for all common purposes, can be made by the use of a voltmeter and an ammeter, together with a couple of dry cells and a switch. In fact, a very rough determination can be made with an ordinary galvanometer and in another case with a single voltmeter, as will be explained later.

Figure 1 shows a method of measuring resistance with a voltmeter and an ammeter. In this case, a little key can be used in place of a switch. The wire should be scraped clean before the binding-posts are screwed down. High-resistance contacts are sure to interfere with accurate results. After the apparatus is connected, the key is pressed and the voltmeter and ammeter read. When the readings of both instruments are made, the resistance of the coil in the circuit may be calculated by following out Ohm's law (resistance = volts ÷ amperes). It will be understood, however, that this method of calculation holds good only when direct current is being used. The formula is changed slightly when alternating-current resistance is measured.



Four ways of measuring electrical resistance are illustrated in these wiring diagrams

When a wiring diagram similar to the one described is used, the resistance of the voltmeter must of necessity be high. If the resistance of this meter is not high it will be necessary to connect the apparatus as shown in Fig. 2. When instruments are connected in this manner, it will be necessary to learn the resistance of the ammeter. The formula given above is followed out, but it will be necessary to subtract the resistance of the ammeter from the total resistance to obtain the required result. When this subtraction is made, the resulting figure will be the resistance of the coil to be measured.

Another method of measuring resistance in a very simple way is illustrated in Fig. 3. This is recognized as the differential galvanometer method of resistance measurement. The connections must be made as illustrated. A two-point switch must be used. It is connected with the circuit as shown. The known resistance is variable. Any good type of laboratory rheostat can be used, providing it has a resistance greater than the resistance of the coil to be measured.

The rheostat should also be graduated so that the resistance will be known at any point. The resistance of the rheostat is carefully adjusted until the galvanometer needle comes to zero. When this adjustment is made, the resistance of the coil to be measured will be the same as that represented by the laboratory rheostat or resistance box. This is a very simple way of measuring resistance and is accurate enough for all common purposes.

Another good way of making measurements in resistance with a single voltmeter is shown in Fig. 4. In this case, a two-pole double-throw switch of the sliding type must be used. If the experimenter does not have this at hand, he can very readily assemble one from materials found about the shop. In this connection it will be noticed that a known resistance will be used. A small resistance spool or even a 75-ohm telephone receiver can be inserted in this part of the circuit to act as a known resistance.

In this instance it is not necessary that the known resistance be greater than the unknown resistance. This method of resistance measurement is known as the drop method. First, the double-throw switch is moved to the left and the drop in voltage across the known resistance is measured. A note is made of this figure. The switch is then moved to the right and the drop in voltage across the unknown resistance is noticed. From these figures it will be possible to measure the resistance. The formula used is a simple one and follows:

$$R = \frac{R^1 \times V}{V^1}$$

R = Unknown resistance
R^1 = Known resistance
V = Voltage drop across unknown resistance
V^1 = Voltage drop across known resistance

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